WATER PLANT OPTIMIZATION STUDY

FORT ERIE ROSEHILL WATER

TREATMENT PLANT

DECEMBER 1993

Ontario

Ministry of
Environment
and Energy

ISBN 0-7729-3296-4

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Cette publication technique
n'est disponible qu'en anglais.

PIBS 2781

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Please note that some of the recommendations contained in this report may have already been completed at time of publication. For more information, please contact the local municipality, or the Water Resources Branch of the Ministry of Environment and Energy.

Note, all references to Ministry of the Environment in this report should read Ministry of Environment and Energy.

WATER PLANT OPTIMIZATION STUDY
FORT ERIE
ROSEHILL WATER TREATMENT PLANT

Summary of Findings and Recommendations

The optimization study for the Fort Erie Rosehill Water Treatment Plant is the start of an ongoing documentation of the operation of the plant. The study is a review of present conditions with emphasis on determining an optimum treatment strategy for removal of particulate matter and improving the disinfection processes. Outlined below is a summary of some of the findings and recommendations of this study.

1. Continue to study the use of alternative coagulants such as polyaluminum chloride and particularly their effect on aluminum residuals.

2. Installation of a streaming current monitor and control equipment to control coagulant dosages, and particularly to study operation of the two halves of the plant, one with and one without a streaming current detector.

3. Installation of individual turbidimeters on each filter effluent.

4. Selection of a method of monitoring sludge depth in the sedimentation tanks.

5. Further review of the practice of returning settled backwash water to the head of the plant to determine the actual effect on the coagulation/flocculation and sedimentation processes.

6. Continue to monitor deterioration of the tube settlers, and if necessary consider replacement with new tube settlers, or with a tilting plant system.

7. Investigate a means of improving sludge scour in the backwash holding tank.

8. Check media gradation, as well as depth, at regular intervals.

Overall, the water quality from the Rosehill Water Treatment Plant is good. The plant consistently produces water with a turbidity less than 1.0 NTU, despite seasonal raw water quality fluctuations.

Bacteriological quality is also consistently good.

INTRODUCTION AND TERMS OF REFERENCE

The Ontario Ministry of the Environment has undertaken Water Plant Optimization Studies at a number of locations. The purpose as stated in the Terms of Reference, is to document and review present conditions, and determine an optimum treatment strategy for contaminant removal at the plant, with emphasis on particulate materials and disinfection processes.

The Water Plant Optimization Studies are also being co-ordinated with the Ministry of the Environment's Drinking Water Surveillance Program (DWSP) since a plant process evaluation is required for each plant entering the program. DWSP provides a continuously updated base of information on water plants and water quality.

This study shows that the Fort Erie Rosehill Water Treatment Plant produces water that meets or betters the Ontario Drinking Water Objectives.

The study has been undertaken in accordance with the Terms of Reference attached to this report as Appendix D.

TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

TABLE OF CONTENTS (cont'd)

TABLE OF CONTENTS (cont'd)

SECTION A - RAW WATER SOURCE

SECTION A. RAW WATER SOURCE

A.1 Source

The Town of Fort Erie draws its water supply through 550 m of 1050 mm diameter corrugated steel pipe intake from Lake Erie. The water is treated at the Rosehill Road Water Treatment Plant. The intake is the last municipal intake from Lake Erie on the Canadian side before it enters the Niagara River.

A.2 Physical Parameters

Over the three year study program, (1984 to 1986) it was observed that the average raw water turbidity varied from 2.5 to 32 NTU. Available data also indicates that raw water turbidities have fluctuated between a minimum of 0.7 NTU and a maximum of 73 NTU. The raw water colour varied from 4 to 8 TCU during the same time period.

A.3 General Chemistry

The raw alkalinity and hardness are quite stable and did not vary more than six percent over the study period. Raw water alkalinity varies between 97 to 104 mg/L as $CaCO3$ and for hardness the range is from 121 to 129 mg/L. The raw water pH varies between 7.5 to 8.5. The above raw water parameters yield a modified Langelier Index in the range of -0.40 to +0.63 which is slightly aggressive to non-aggressive.

From Proctor and Redfern's Pre-Design report (Jan. 1976), it is noted that aggression control of the treated water was recommended. However, to date, the addition of chemicals to increase the Langelier Index has not been practiced.

A.4 <u>Biological Parameters</u>

Throughout the 1984 - 1986 study period, every monthly raw water sample showed fecal coliform counts ranging from 2 per 100 mL to 87 per 100 mL sample. In every case, the treated samples showed no evidence of fecal or total coliforms.

In the 1976 Pre-Design Report, it was stated that "the bacteriological quality of the water (raw) is good and can be readily handled with normal disinfection procedures".

Algae testing is performed at the Rosehill plant. In January 1976 during the pre design stages of the plant, Proctor & Redfern reported on an early (1966-67) sampling program performed by the Ministry of the Environment. It was stated that the normal maximum ASU counts at Fort Erie were less than 1000 with a downward trend over the latter part of the study. Diatoms counts were between 500 - 600 ASU with heavy blooms between mid December to February, in April to mid May and again in October. Flagellates, which primarily cause a taste and odour problem were measured up to 100 ASU in mid May of this original study period.

SECTION B FLOW MEASUREMENT

SECTION B. FLOW MEASUREMENT

B.1 Raw

The 900 mm diameter raw water main from the low lift pump splits into two 400 mm diameter pipes at the plant inlet.

The raw water flow is measured by two 400 mm venturi tubes with a throat width of 379.4 mm and a differential of 0 to 305 mm. Each venturi tube is rated at flows from a minimum of 11,000 to a maximum of 25,000 m^3/d. The average flow for the study period was approximately 16,000 m^3/d through each meter, for a total of 32,000 m^3/d. During low flow periods, one half the plant is used only, so that the one raw water meter is used, and flow remains within the meter range.

B.2 Treated

The method of measuring treated water flow is by a magnetic flowmeter and plant (internal water) meters. The scale on the flowmeter for measuring plant discharge is from 0 to 70,000 m^3/d. The average flow was approximately 15,000 m^3/d.

B.3 Backwash

A 750 mm insert venturi with a throat size of 442 mm and a differential of 0 - 305 mm is located on the backwash supply. It measures a flow from a minimum of 13,000 to a maximum of 64,000 m^3/d. A 150 mm insert venturi is located on the backwash recycle. It has a throat size of 110.7 mm and a differential of 0 to 305 mm and measures a flow from a minimum of 3,500 to a maximum of 6,000 m^3/d.

B.4 Filtered

The method of measuring the filter effluent is by four 350 mm insert venturi tubes, each with a throat size of 221.3 mm and a differential of 0 - 305 mm. Each measures a flow rate from a minimum of 7,000 to a maximum of 22,000 m^3/d.

B.5 Validity

It is confirmed through conversation with operations staff from Regional Niagara that the flow measuring devices are checked twice a year during the spring and fall for accuracy and calibration by an outside instrumentation company specializing in this work. During the study period no major recalibration has been performed on the flow transmitters.

B.6 Recording

The following flows are continuously recorded and totalized:

Raw water
Treated Water
Recycle

SECTION C - PROCESS COMPONENTS

SECTION C. PROCESS COMPONENTS

C.1 General

This section includes detailed information on the unit processes and systems within the Rosehill Road Water Treatment Plant.

The water treatment plant was placed into service in May 1980. The plant uses constant rate conventional treatment (ie., Flocculation, Sedimentation and Filtration). The plant has the capability to operate as two halves, by splitting the flow through two raw water control valves. A basic block diagram is attached.

C.2 Design Data

a) Plant Capacity

The first stage of the water treatment plant has a rated capacity of 50,000 m^3/d. A future similar stage would bring the capacity up to 100,000 m^3/d.

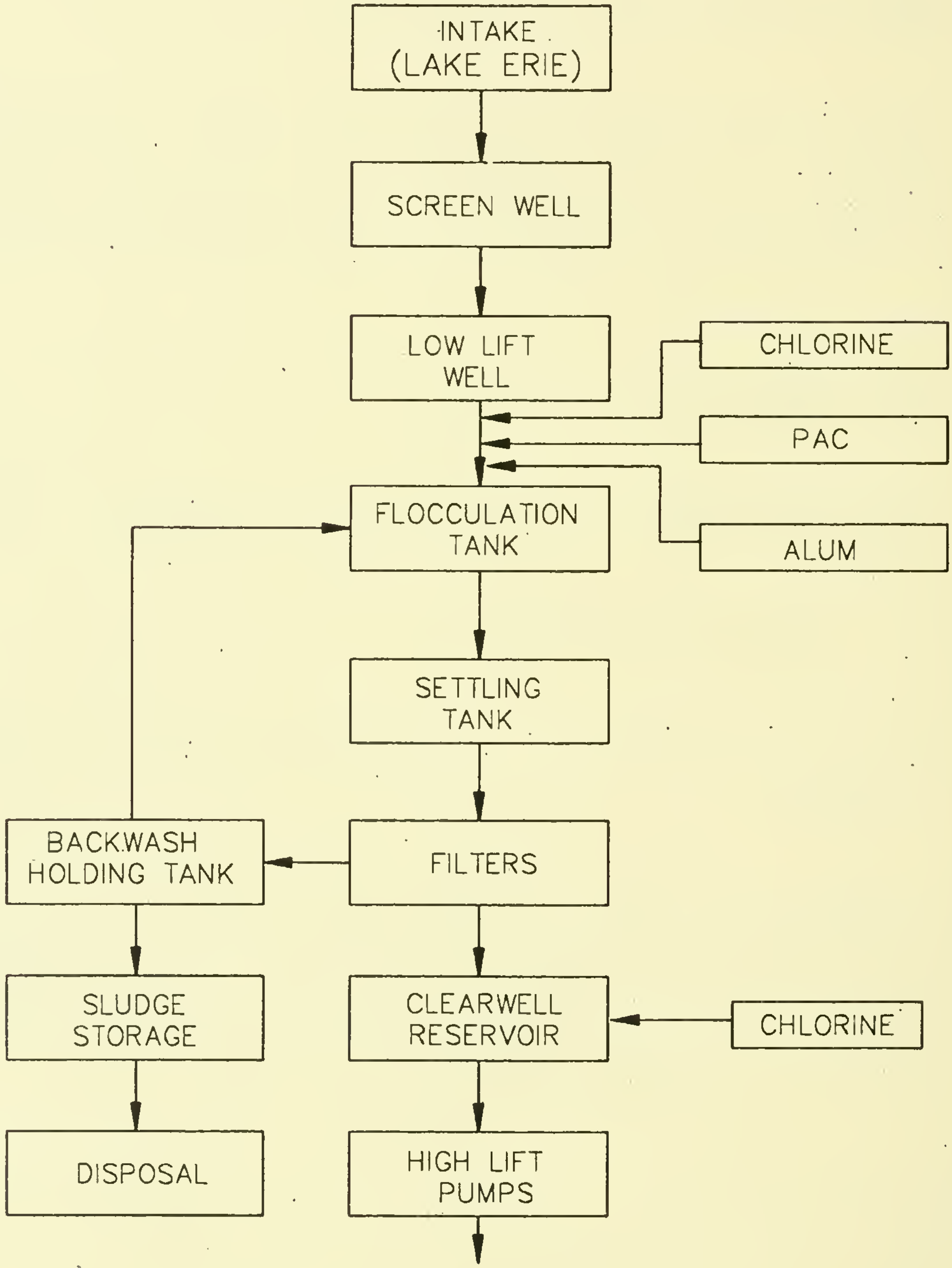
b) Factors Affecting Capacity

A potentially limiting factor is the capacity of the existing 1050 mm diameter intake. At low lake levels (ie. 172.8 m) the existing intake has a capacity of 54,500 m^3/d.

Pumping capacities under normal and power failure conditions are different from the rated capacities of the various plant unit processes. This is dealt with in the following sections of this Report. The firm low lift capacity is 53,000 m^3/d at a rated head of 7.0 metres, and the firm high lift capacity is 50,400 m^3/d under normal power conditions at a rated head of 70.4 metres.

FORT ERIE WATER TREATMENT PLANT

BLOCK DIAGRAM



C.3 Process Component Inventory

a) Intake

The intake is a 1050 mm diameter corrugated steel pipe extending into Lake Erie approximately 550 m. It was existing at the time of construction of the new plant. The intake is rated at 68,000 m^3/d at a lake level of 174 m. The intake crib is constructed from timber and precast sections and is situated in approximately 4 m of water at an elevation of 170.07 m.

The intake crib and pipe were repaired circa 1979. Several large gashes, which permitted silting and severely limited the capacity of the intake, were closed. Several areas of the intake pipe had silt build up of approximately 600 to 750 mm and during the repair work the silted areas were removed.

At the low lift pumping station the intake terminates at a manually operated sluice gate. The flow is then directed into two pump wells.

b) Screening

The raw water wet well is divided into two cells. The travelling screens, one per well (0.9 m wide) , are side outlet flow type and are sized to pass 45,000 m^3/day/screen with a head loss of 150 mm. Each screen is equipped with #12 wire gauge stainless steel mesh with 6 mm square clear openings. The cleaning of the screens can be either manually initiated or automatically initiated on excessive head.

c) **Low Lift Pumping**

The ratings for the raw water pumps are as follows:

Pump No.	Capacity l/s	Head m	Type	KW	Manufacturer
1	162	7.0	Vertical Turbine	30	Fairbanks Morse
2	289	7.0	Vertical Turbine	56	Fairbanks Morse
3	289	7.0	Vertical Turbine	56	Fairbanks Morse
4	162	7.0	Vertical Turbine	30	Fairbanks Morse

The installed capacity of the low lift pumping station is 98,000 m^3/d (902 l/s) with a firm station capacity (1 large pump out) of 53,000 m^3/d (613 l/s) under a normal power mode. Under standby power mode the following pump or pump sequence can be started to provide limited capacity:

Pump 1 only:	14,000 m^3/day (162 l/s) at 7.0 m.
Pump 3 only:	25,000 m^3/day (289 l/s) at 7.0 m.
Pump 2 & 4:	39,000 m^3/day (451 l/s) at 7.0 m.

Limited low lift capacity under standby power was provided due to the large treated water reservoir located at the water treatment plant site. The low lift pumps are manually controlled from the water treatment plant and are automatically shut down under the following conditions:

- Power Failure

- Low Wet Well Level
- Thermal Overload
- Telemetry Signal Failure

The raw water is pumped to the water treatment plant through 500 metres of 900 mm diameter concrete pressure pipe.

The flow enters the water treatment plant and splits into two 400 mm diameter lines, each with its associated in-line blender, venturi and electrical modulating butterfly valve. Each valve can be controlled from the operator's console by entering a manual set point to maintain the required flow to the pretreatment units and hence keep the level on the filters constant.

d) **Flash Mixing**

The plant was originally equipped with two 400 mm diameter in-line blenders, each sized for an effective flow range of 11,000 - 25,000 m^3/d. Each Lightnin Model LBC-27-150 unit was fitted with a 3.75 KW motor operating at 1150 rpm and with an impeller diameter of 142 mm. Due to excessive maintenance, the units have been taken out of service and removed from the system as discussed in Section D.2 of this Report.

e) **Flocculation**

The plant utilizes six flocculation tanks, each 5.1 m x 5.1 m x 4.7 m deep. The flocculation tanks can be operated as two pairs of three in series for tapered flocculation in the conventional treatment (sedimentation) mode, or as one per set with two shutdown in series for a direct filtration mode. Each tank is baffled and utilizes a Lightnin flocculator mixer equipped with manually adjustable speed control. Each mixer is driven by a totally enclosed fan cooled motor and is designed for a G value range at $2^{o}C$ as shown in the following Table.

Flocculator No.	G Range	KW	Speed	Model No.
1,4	70 - 200	11	1750	74Q - 15
2,5	30 - 60	1.5	1150	71Q - 2
3,6	20 - 50	1.1	1150	71Q - 1.5

The detention time can vary depending on plant flow and is tabulated as follows:

	Detention Time		
Flow/Flocculator m^3/d	**Per Tank (minutes)**	**Gt Range**	**Tapered Flocculation (Three tanks in series) (minutes)**
7,000	25.14	$105 - 300 \times 10^3$	75.44
11,000	16.00	$29 - 58 \times 10^3$	48.00
25,000	7.04	$8 - 21 \times 10^3$	21.12

Flow is introduced to the No.1 and No. 4 tanks at the bottom, directly from the in-line blenders and influent pipe. Flow is then turned vertically upward in the first pair of tanks then downwards in tanks No. 2 and 5 and upwards in tanks No. 3 and 6. Tanks 2 and 3 as well as 5 and 6 can be bypassed using slide gates for the direct filtration mode. At a plant flow of 50,000 m^3/d, ie. 25,000 m^3/d per side, the velocities through the inlet ports to each flocculator are as follows:

Inlet To	Velocity
Floc. No. 1 & 4	2.23 m/s
Floc. No. 2 & 5	0.52 m/s
Floc. No. 3 & 6	0.52 m/s
Settling Tank 1 & 2	0.20 m/s

f) **Sedimentation**

Flow from Flocculators No. 3 and 6 is introduced to the sedimentation tanks through an underpass baffle in order to equally distribute the pretreated flow. There are two 16.9 m x 10.2 m x 4.7 m deep (810 m^3) sedimentation tanks fitted with Graver ABS tube settlers. These are manufactured from ABS plastic, inclined at 60^o to the horizontal and are approximately 580 mm deep.

The tanks are rated at 6.6 m/hour at 50,000 m^3/day. The total detention time in the tanks at 50,000 m^3/day is 45 minutes.

Settled water is collected by fourteen lateral fiberglas launders (300 mm wide) and funneled to a central collection channel (one per settling basin). This channel is approximately 1.2 m wide by 0.6 m high and passes back through the flocculators to the filter inlet channel. The weir plates on each launder incorporate 75 mm deep, 90^o Vee notches at 140 mm centers.

Sludge collection consists of 1.2 m deep V-shaped troughs running longitudinally the length of each sedimentation tank. The collector pipes consist of 18 - 25 mm diameter openings in 75 mm diameter P.V.C. piping at 300 mm centers.

The operation of the blowdown valves associated with these pipe collectors is manually initiated and allows settled sludge to be discharged to the backwash holding tank.

g) **Filters**

The plant contains four dual media filters each 9.75 m x 5.0 m x 3.9 m deep consisting of the following physical system:

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Underdrain: Roberts "Wheeler" underdrain system.

Support Media:	300 mm depth gravel graded from 38 to 2 mm.
Sand:	200 mm depth with an e.s. of 0.55 and a u.c. of 1.5 per AWWA B100-72 Section 2.2.
Anthracite:	500 mm depth with an e.s. of 1.1 and a u.c. of 1.41 per AWWA B100-72 Section 2.3.

Over time media loss and deterioration can occur in the filter bed. Each year the bed depths are checked and media topped up if necessary. Regular sieve analyses should also be implemented. The following elevations form the basis of depth monitoring:

Top of Filter Box	EL	185.76 m
Top of Water	EL	185.06 m
Top of Trough	EL	189.30 m
Top of Anthracite	EL	182.68 m
Top of Sand	EL	182.17 m
Top of Gravel	EL	181.97 m
Top of Underdrain	EL	181.67 m
Bottom of Filter Box	EL	181.40 m

Filter effluent turbidity is measured using one Lisle Metrix A270 turbidimeter. On a rotating basis, each filter is sampled over a 15 minute time interval. Filter influent turbidity is measured every 4 hours. Raw water turbidity (prior to entering the low lift pump wells) is grab sampled and measured using a Hach 2100 A turbidimeter. Normal raw water turbidity ranges from 5 to 10 NTU and filtered water turbidity ranges between 0.2 to 0.5 NTU (as can be seen in Table 2.1).

Generally, filter runs of 72 hours are achieved. The clean bed loss varies with filter throughput. The filters are designed for a filter rate of 10.5 m/hr, although operation in excess of this rate has been achieved. One of the parameters that terminates a filter run is filter head loss, which is currently set at 2.0 m.

During the winter the plant is operated on two of the four filters due to the severe seasonal variation in flow. The west half of the plant is normally used, since the recycle inlet is located on this half of the plant.

The backwashing of filters is performed manually at the plant control console. The backwash procedure allows for variable wash rates based on temperature and also has adjustable duration for low and high rate washes. The plant backwash system is capable of delivering a peak backwash rate of 60 m/hr (ie. 750 l/s) with a normal backwash rate of 560 l/s or 45 m/hr.

The backwash pumps are of the vertical turbine type. They are located in the high lift pump room and have the following ratings:

Backwash Pump Number	Flow l/s	Head m	Manufacturer	KW
1	750	10.6	Peerless	150
2	750	10.6	Peerless	150

Each filter is also equipped with a Roberts surface wash system (nominal wash rate of 6.0 m/hr. at 585 kPa).

Each filter also incorporates a 200 mm diameter filter to waste system. This system is rarely used by Operations Staff after backwashing and prior to commencing filtration. Operation of the filters is manual (see Section D) and consequently the filters are brought back on line slowly following washing.

h) **Clearwells**

All treated water storage is constructed of concrete. The total usable volume of filtered water storage is approximately 10,410 m^3, made up as follows:

	Usable Volume (m^3)	Overall Dimensions
Clearwell 1 (includes filtered water channel)	730	9.75 x 22.90 x 4.90 m
Reservoir 1	4280	20.0 x 47.60 x 6.0 m
Reservoir 2	4280	20.0 x 47.60 x 6.0 m
High Lift Pump Well 1	560	9.75 x 8.2 x 7.2 m
High Lift Pump Well 2	560	9.75 x 8.2 x 7.2 m
Total	10,410 m^3	

i) **High Lift Pumping**

The high lift pumping station is located at the rear of the plant and is situated next to Clearwell No. 1 and Reservoir No. 1. There are presently four high lift pumps located in the station and they have the following ratings:

High Lift Pump Number	Flow l/s	Head m	KW	Manufacturer
2	318	70.4	300	Peerless
3	104	70.4	112	Peerless
4	162	70.4	150	Peerless
5	318	70.4	300	Peerless

Firm capacity is therefore set at 584 l/s (50,500 m^3/d) with the No. 2 or 5 pump out of service. Total capacity is 902 l/s or 78,000 m^3/d with all four units operating.

The station is laid out to accommodate two additional high lift pumping units and also incorporates the backwash pumping units and a 250 mm diameter high lift pressure relief system.

j) **Backwash Treatment**

The 11.75 m x 25.1 m x 3.1 m high (approximate) backwash water surge and holding tank is located beneath the settling tanks, in order to provide settling and storage of backwash water.

Backwash water is allowed to settle for a minimum of two hours (adjustable) before the clear supernatant is pumped back to the raw water main. The supernatant is drawn off by a swiveled supernatant arm. This pump is controlled from the operator console and it has the following characteristics:

Pump	Flow l/s	Head m	Manufacturer
Supernatant	57	12.2	Flygt

k) **Sludge Disposal**

The sludge is settled in a long hopper located inside the backwash holding tank and is pumped to the sludge holding tanks for ultimate disposal to a tanker truck.

The following pumping equipment is used:

Pump	Flow l/s	Head m	Manufacturer
Desludge Pump	7.6	7.6	Robbins-Myers
Sludge Transfer	7.6	7.6	Robbins-Myers

The sludge pumps and holding tanks are located in the Bulk Chemical Room, situated below the sedimentation tanks. The desludge pump is used to draw off solids from the backwash tank to the primary sludge holding tank. The sludge transfer pump performs several functions as follows:

- As the level in the sludge holding tanks rises, the pump circulates the supernatant back to the backwash tank.

- As required, the contents in the sludge holding tanks are discharged to the tanker trucks for off-site disposal.

The two sludge holding tanks are constructed of Fibre Reinforced Plastic (FRP) and have a total capacity of 36,300 litres. A swivel decant line located in the No. 1 Sludge Holding Tank is piped to the suction side of the sludge transfer pump. The supernatant from here can be pumped back to the backwash holding tank or flow by gravity to No. 2 Sludge Holding Tank.

During periods of high solids build up, the sludge holding tanks may be full and excess material can be stored in the backwash waste holding tank. The desludge pump can discharge the solids directly to the second sludge holding tank or directly to the tanker truck. The system was designed for an anticipated sludge concentration in the order of 0.5 to 1.0%. Reports from the operating personnel indicate a sludge concentration of up to 16%. The sludge disposal system has a high degree of flexibility for storing and discharging sludge. A schematic indicating the flexibility of the system is included in the Appendices.

C.4 Chemical Systems

a) Disinfection

Liquid Chlorine is stored in a separate area in the water treatment plant. It is delivered in 900 Kg containers and the plant is capable of stocking eight containers. Chlorine usage is measured on one scale, capable of handling two cylinders.

Three chlorinators are located in a room adjacent to the chlorine storage area. These units are manufactured by Wallace and Tiernan Ltd. and the rotameters currently installed have the following ratings. Higher capacities could be achieved with different rotameters.

Pre Chlorinator	90 kg/day
Post Chlorinator	45 kg/day
Post (touch-up) Chlorinator	45 kg/day

Chlorine is dosed at the raw water main just as it enters the plant (pre-chlorination), and in the chlorine contact chamber at the clearwell (post chlorination). Provision also exists to provide touch-up chlorination in the plant discharge main just upstream of the magnetic flowmeter, although this facility is not currently used. The clearwells provide 21 minutes contact time at the plant rated flow of 50,000 m^3/day.

b) Coagulant

Liquid aluminum sulphate is supplied in bulk and stored at the water treatment plant in two 22,750 litre fiberglas tanks. The coagulant is dosed directly upstream of the flocculation tanks. Although in-line blenders were originally used, they have been removed. There are two duty aluminum sulphate pumps and a standby pump.

The liquid aluminum sulphate is delivered through a chemical distribution header such that if raw water is being pumped to the flocculator, the metering pump is running allowing the coagulant to be fed at the appropriate in-line blender. (As previously noted, the in-line blenders themselves are not in operation.)

The rating of the Wallace and Tiernan chemical pumps are:

Duty Pumps (2)	350 L/day to 1890 L/day
Standby Pump	350 L/day to 1890 L/day

All the chemical pumps, including the alum metering pumps at the plant are the diaphragm, positive displacement type with manually adjustable (four pulley) belt drives. All the chemical pumps have SCR variable speed drives. These are capable of a feed rate adjustment based on a 4-20 mA signal, which allows an operating range of up to 10:1.

The plant originally contained facilities for the use of sodium chlorite (for chlorine dioxide generation), polymer (as a coagulant aid) and sodium hydroxide (for pH adjustment).

These facilities are no longer in use, and with the exception of the sodium hydroxide, dosing equipment has been removed.

In lieu of sodium chlorite and chlorine dioxide, which were reported to impart a taste to the treated water, powdered activated carbon is now used effectively for taste and odour control.

Trials with polyaluminum chloride have been successfully undertaken as an alternative coagulant or coagulant aid.

The following is a list of chemicals that are presently being used at the water treatment plant:

Chemical	Composition	Application	Control
Liquid Chlorine	Gas	Pre-position - 900 mm raw water main	Flow paced (from summated raw water flow)
		Post-position - chlorine contact chamber directly downstream of the filters	Compound loop: Clearwell chlorine residual and summated raw water flow
		Touch-up - high lift discharge	Manual (not usually required)
Aluminum Sulphate	48.5 percent A12(SO4)$_3$ 18H2O	In-line blender location	Flow paced (from summated raw water flow)
Polyaluminum Chloride (PACL)	33 %	In-line blender location	Flow paced (trail basis only)
Powdered Activated Carbon (PAC)	Dry Powder	900 mm raw water main	Flow paced

C.5 Control and Instrumentation

The filter plant is equipped with a hard wired analog control system located on the second floor of the plant between the flocculators and filters.

The system permits control of the following systems and major process blocks.

- Low Lift Pumping Station
- Raw Water Flow Control
- High Lift Pumps
- Backwash Pumps
- Filter Backwashing
- Fort Erie South Elevated Tank Control
- Crescent Park Elevated Tank Control
- Strip Chart Generation

C.6 Sampling

All sampling lines within the water treatment plant are 12mm (1/2 inch) diameter stainless steel piping. The sampling lines are centrally located within the pipe gallery and basement levels allowing easy retrieval of samples. Samples are taken from the raw water line, each effluent channel of the sedimentation tanks, off each filter, and the clearwell.

C.7 Standby

The treatment plant has a 550kw diesel generator to supply power in the event of a power failure. Particular combinations of high and low lift pumps may be selected, along with all chemical metering pumps and emergency lighting. The following are the pump selections available under standby power from the diesel generator.

Low Lift Pump Sequence

No. 1 only or
No. 2 & 4 or
No. 3

High Lift Sequence

No. 3 or
No. 5

Backwash Pump Sequence

No. 2 only.

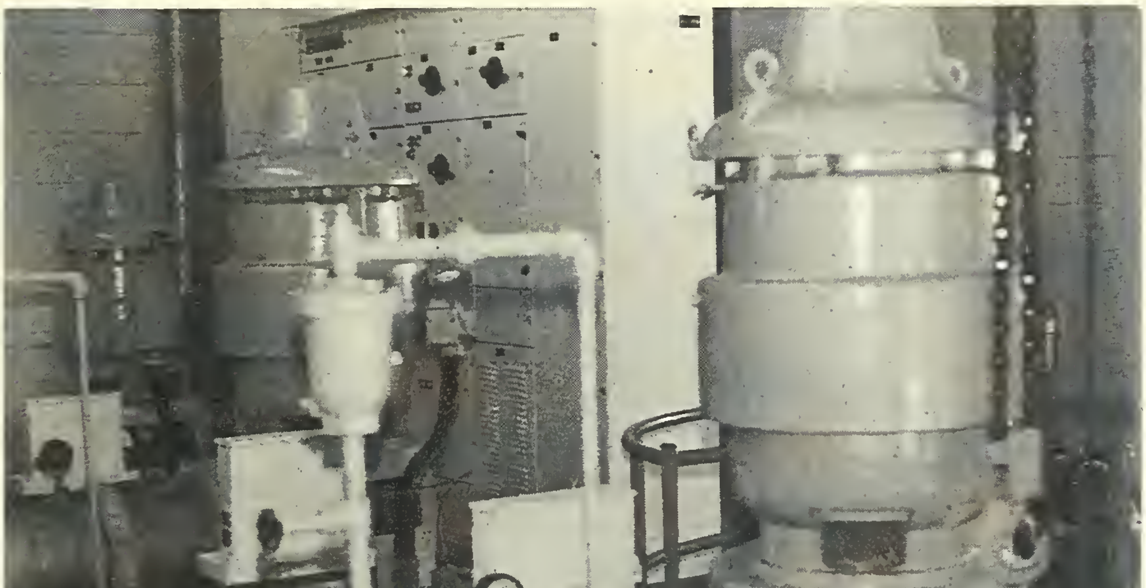
C.8 <u>Photographs</u>

A series of photographs to illustrate major components and chemical feed systems follows this Section.

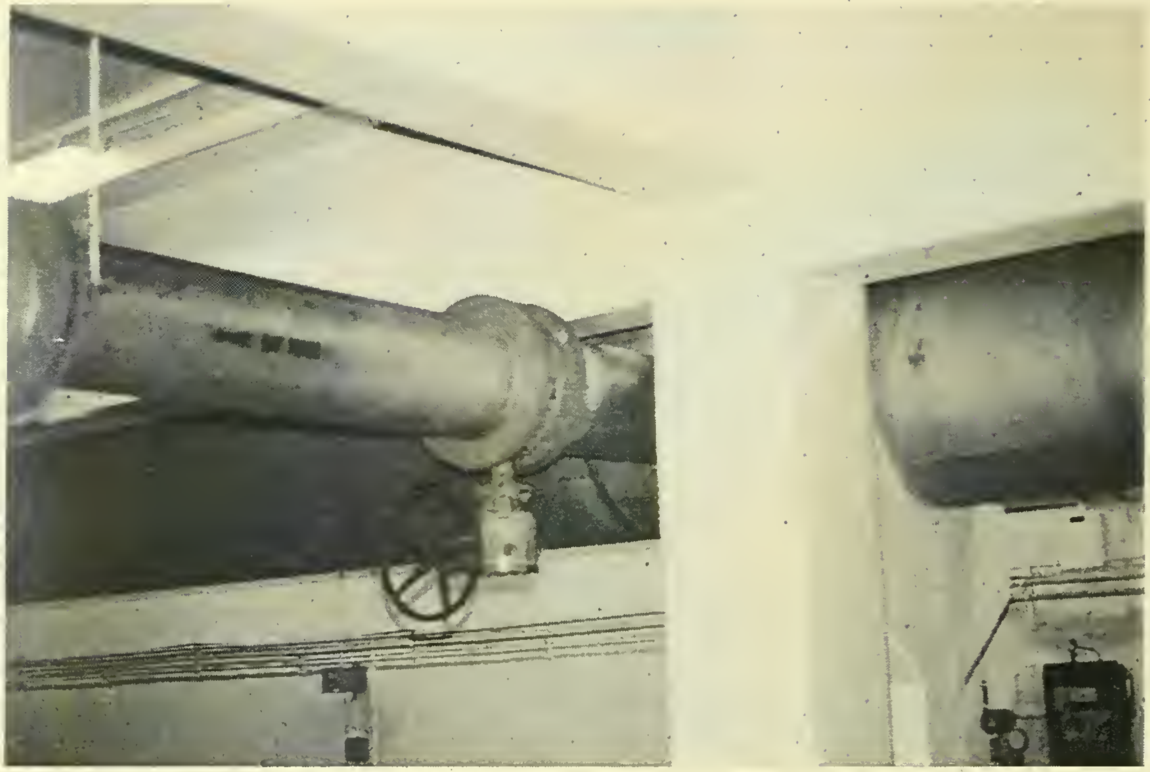
In addition, the following drawings are included in the Appendix:

(a) Block Schematic Rosehill WTP
(b) Figure 1 - Backwash Flow Rate
(c) Figure 2 - Backwash Control Sequence
(d) Figure 3 - Sludge Holding Tank (basement level)

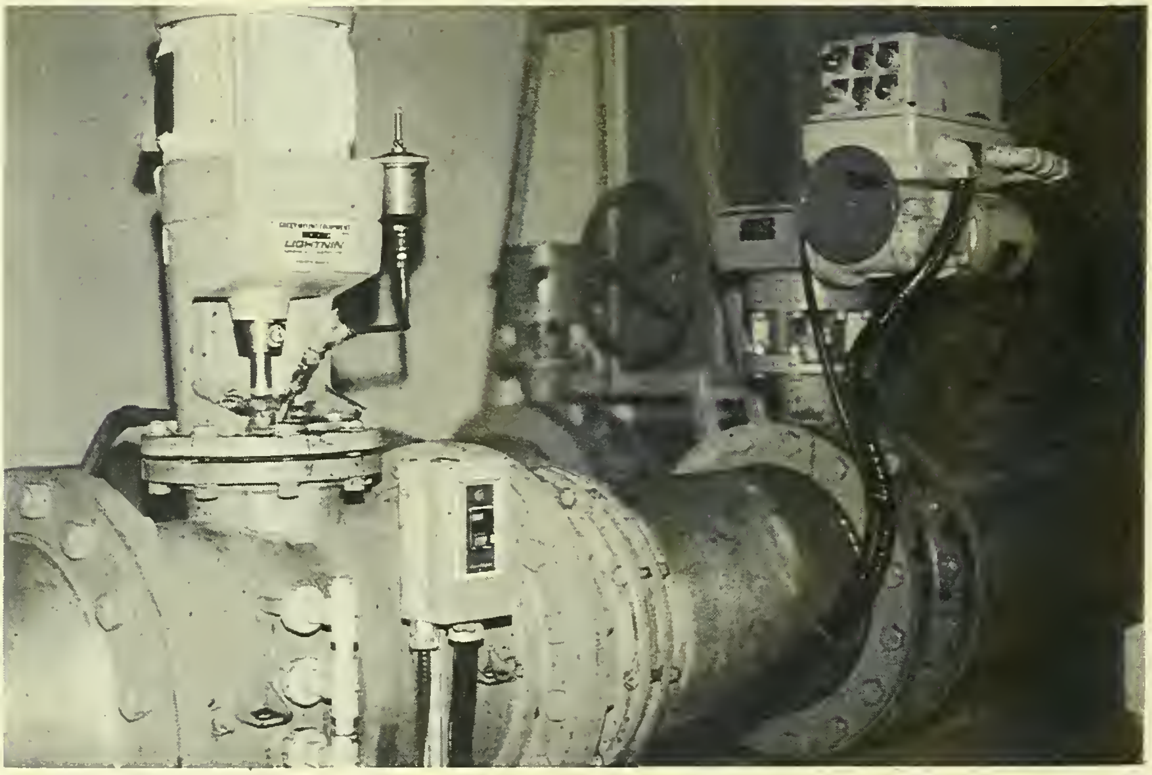
1. ROSEHILL WATER TREATMENT PLANT



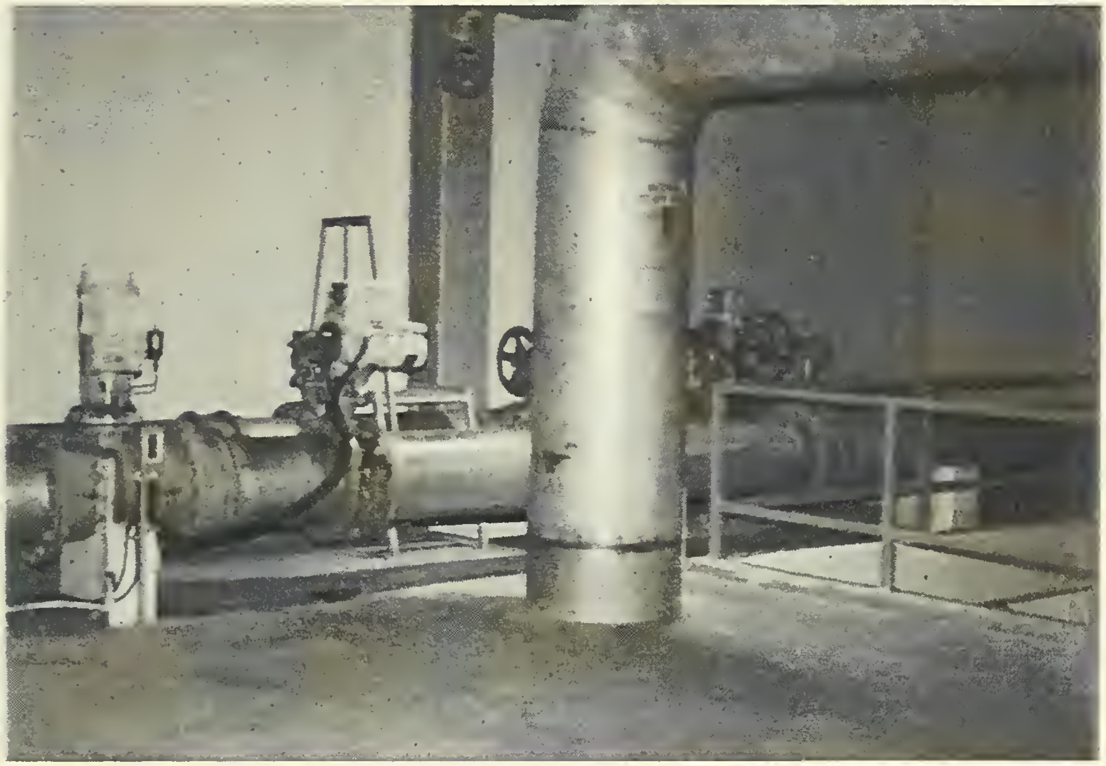
2. LOW LIFT PUMPS AT INTAKE



3. RAW WATER INFLUENT PIPING

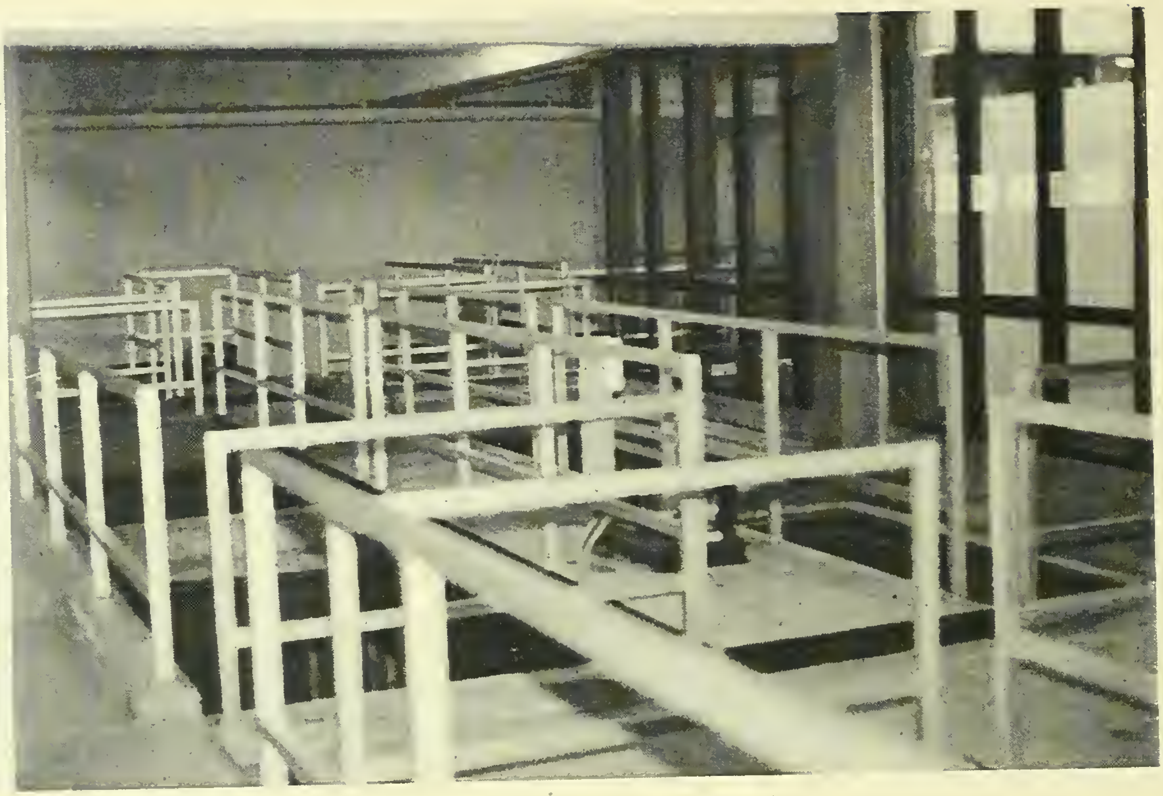


4. IN - LINE BLENDER

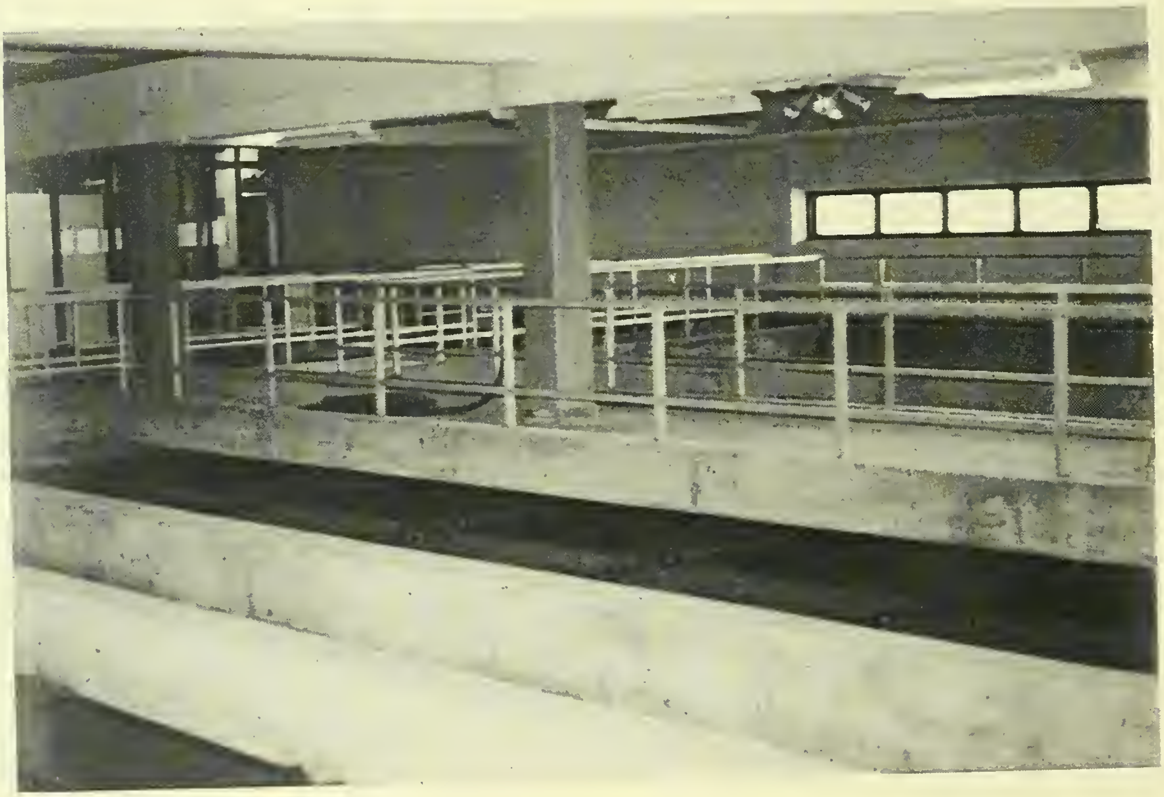


5. RAW WATER INFLUENT PIPING

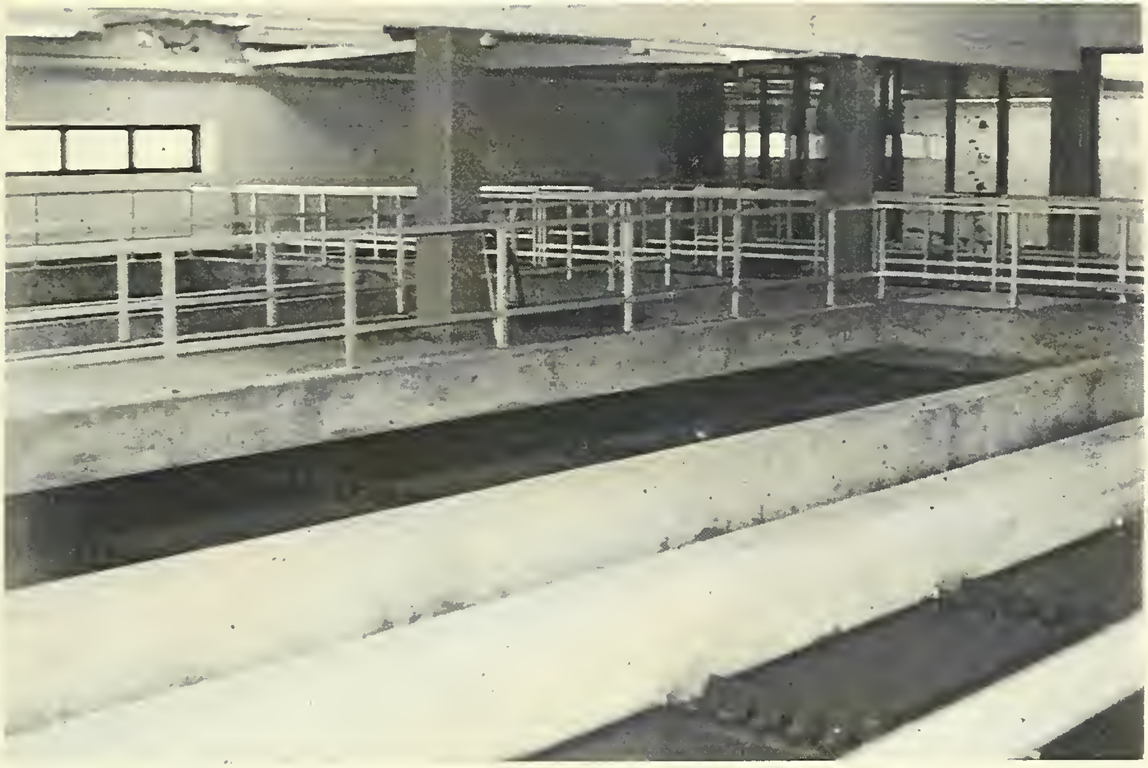
6. VIEW OF FLOCCULATION TANKS FROM CONTROL ROOM



7. FLOCCULATION TANKS



8. SEDIMENTATION TANKS



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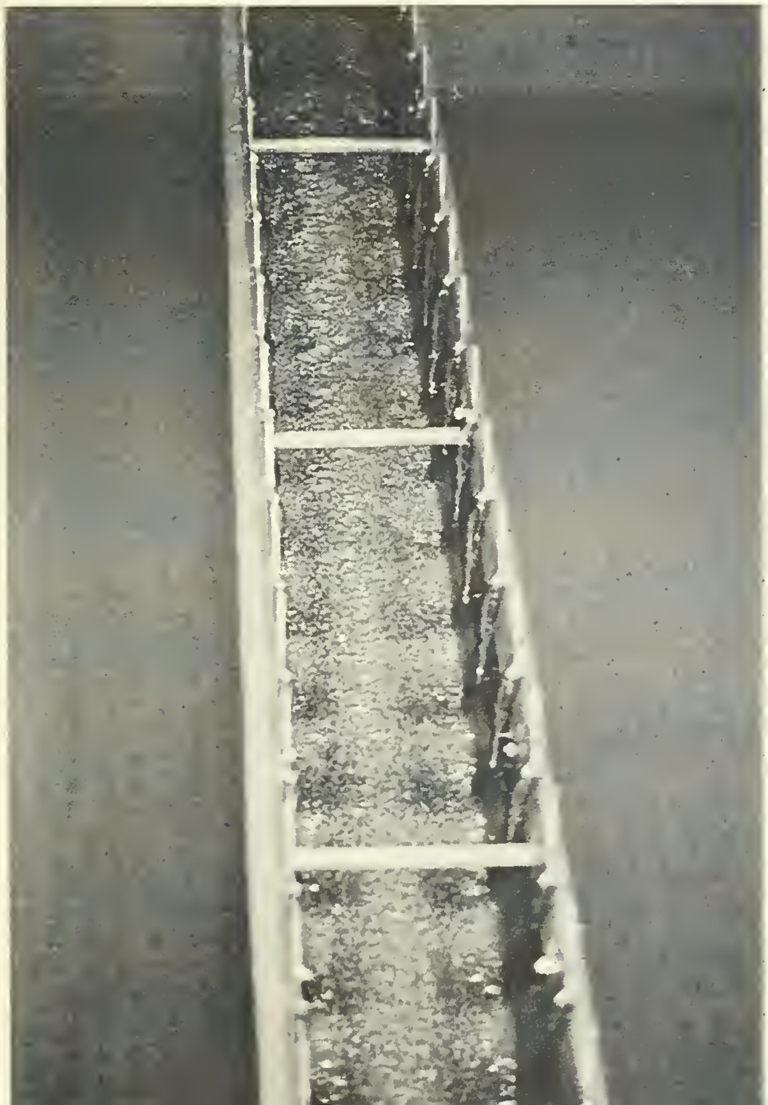
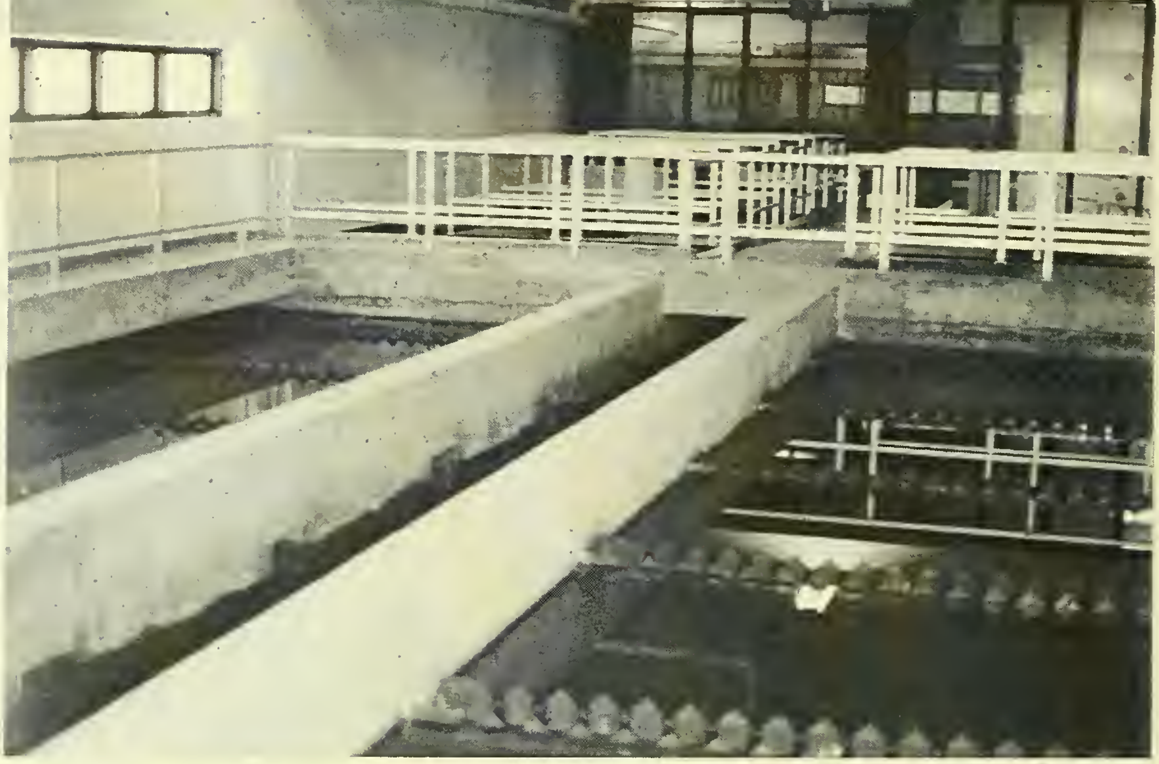
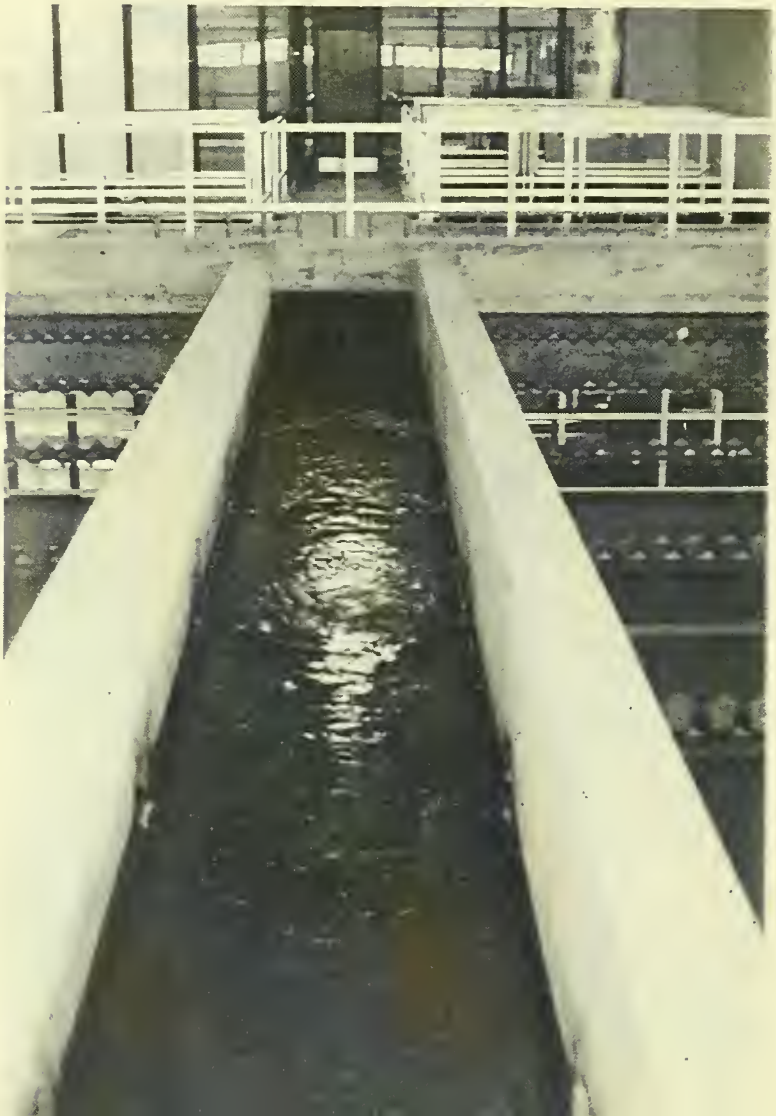


10. SEDIMENTATION TANK
(WITH TUBE SETTLER

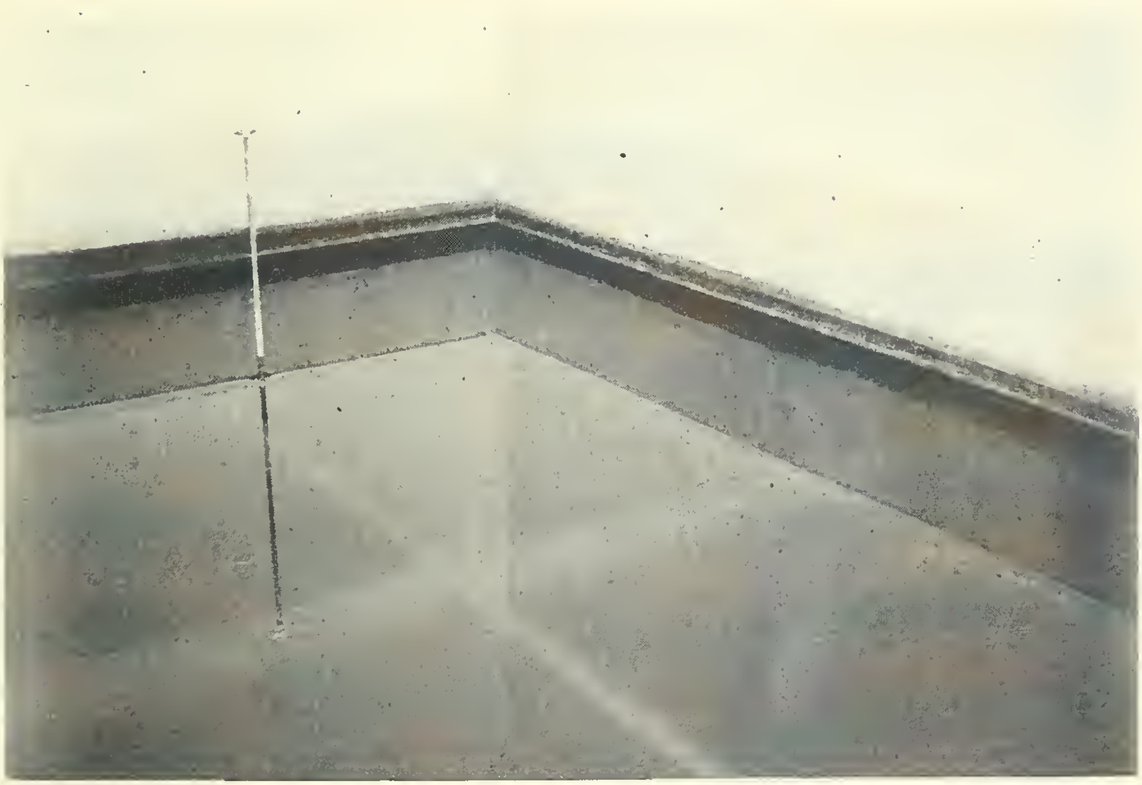


11. SEDIMENTATION TANKS

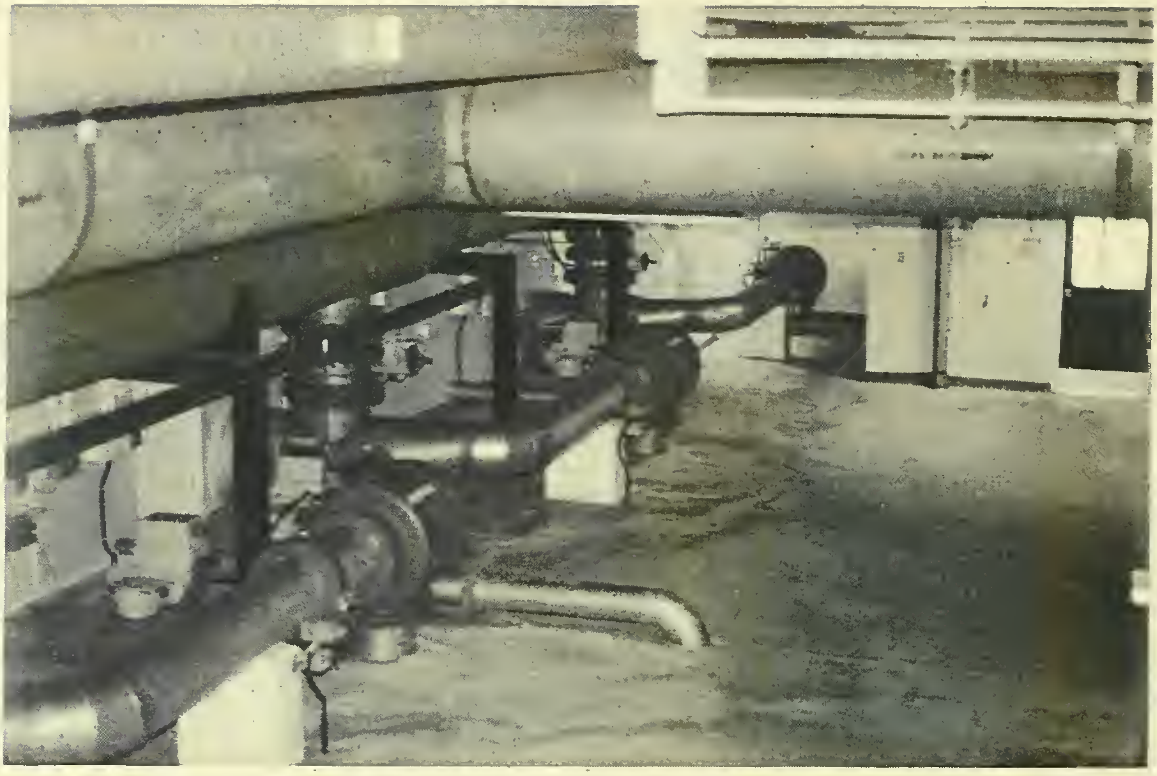


12. FILTER INFLUENT CHANNEL

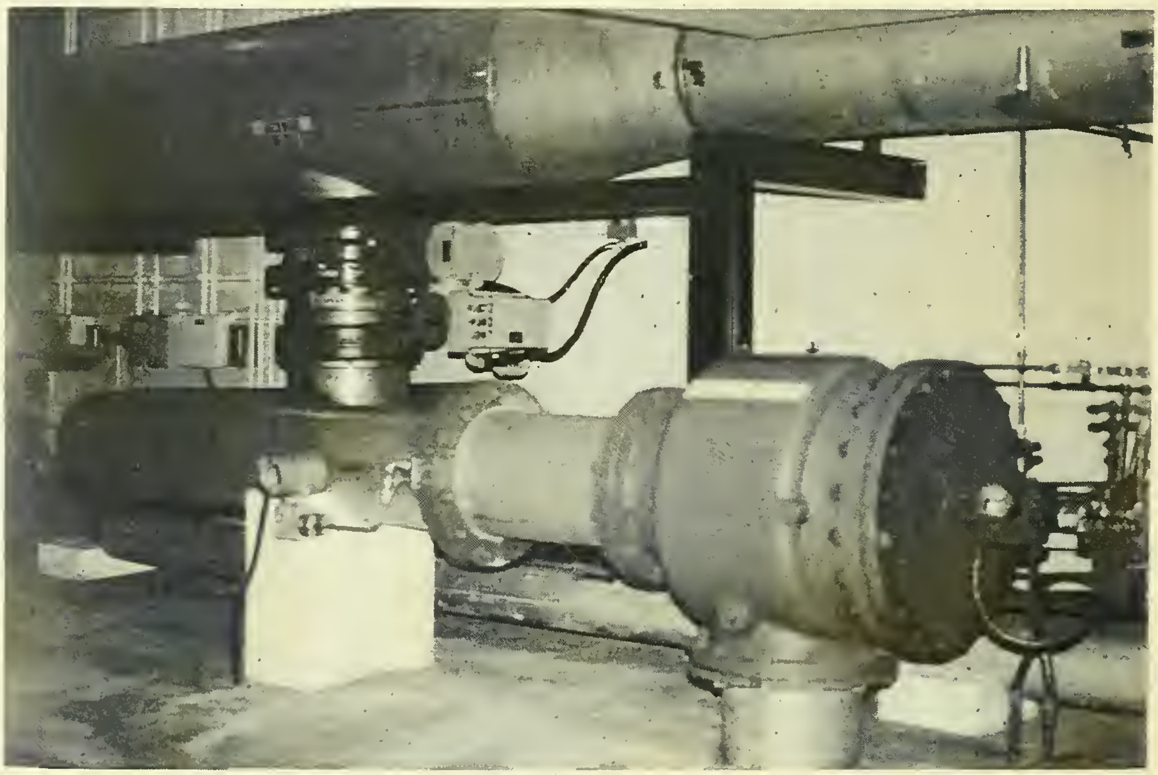
13. FILTER INFLUENT CHANNEL



14. FILTER TANK



15. FILTER PIPING GALLERY



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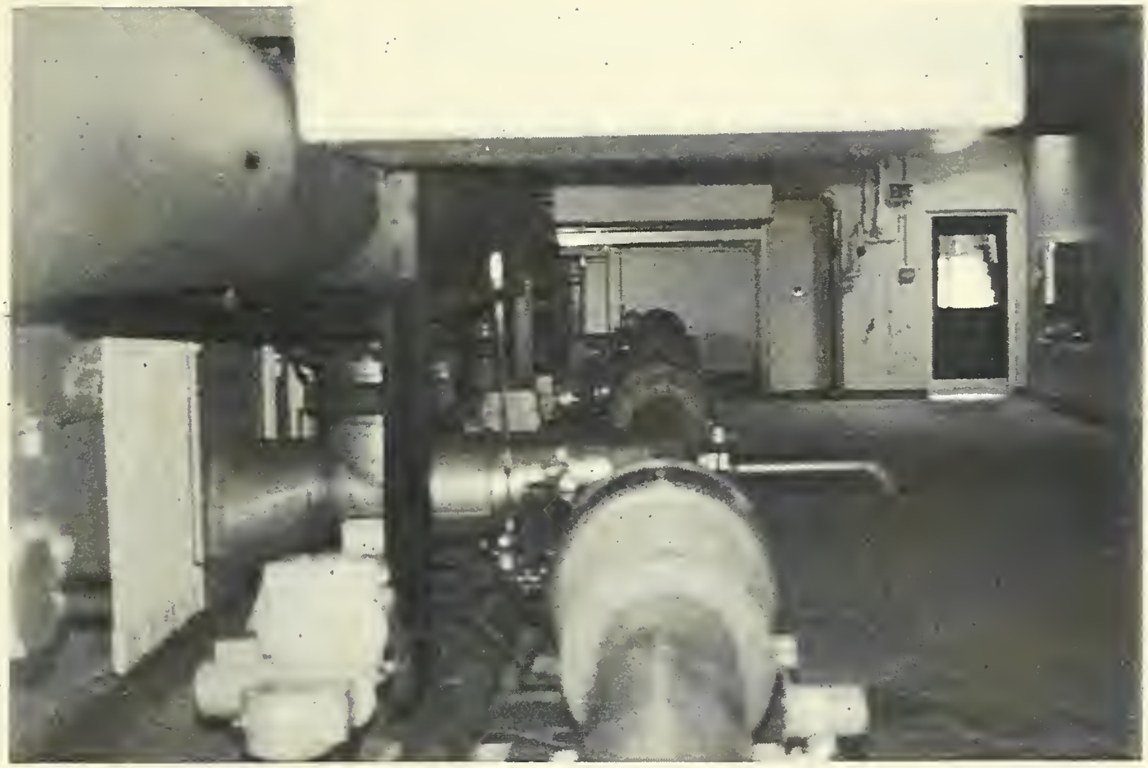

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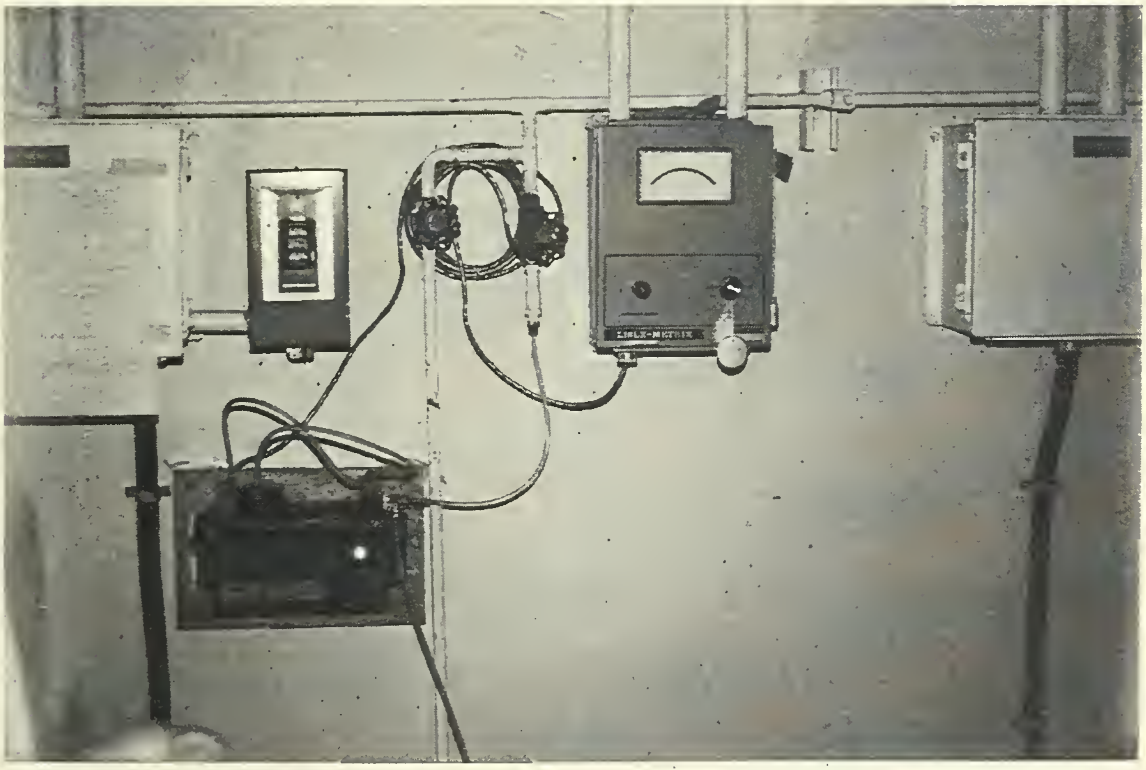
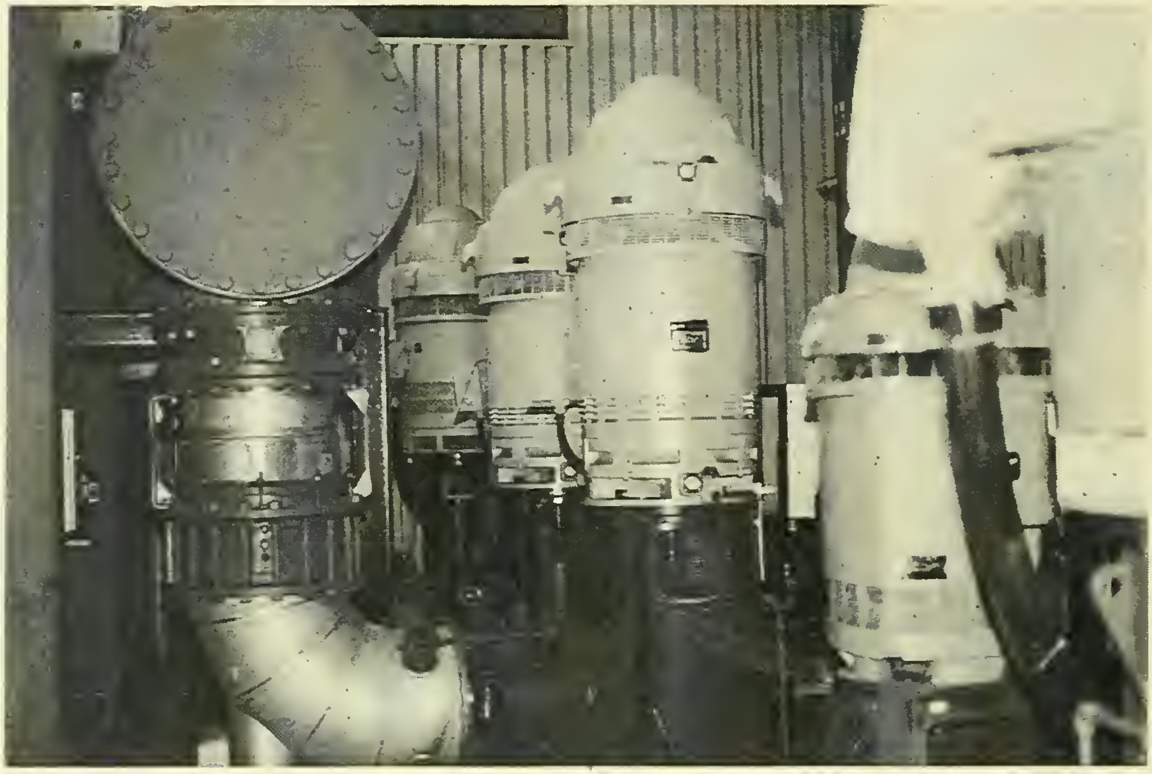
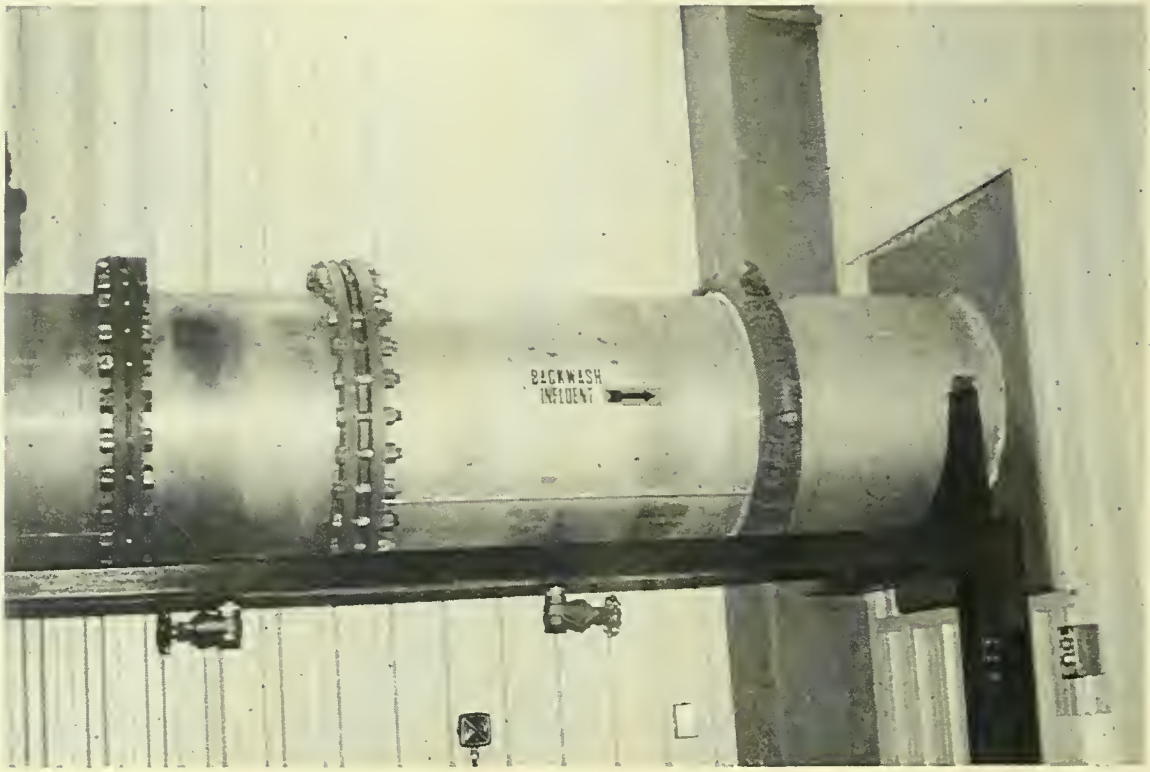


18. FILTER EFFLUENT TURBIDIMETER



19. BACKWASH INFLUENT HEADER



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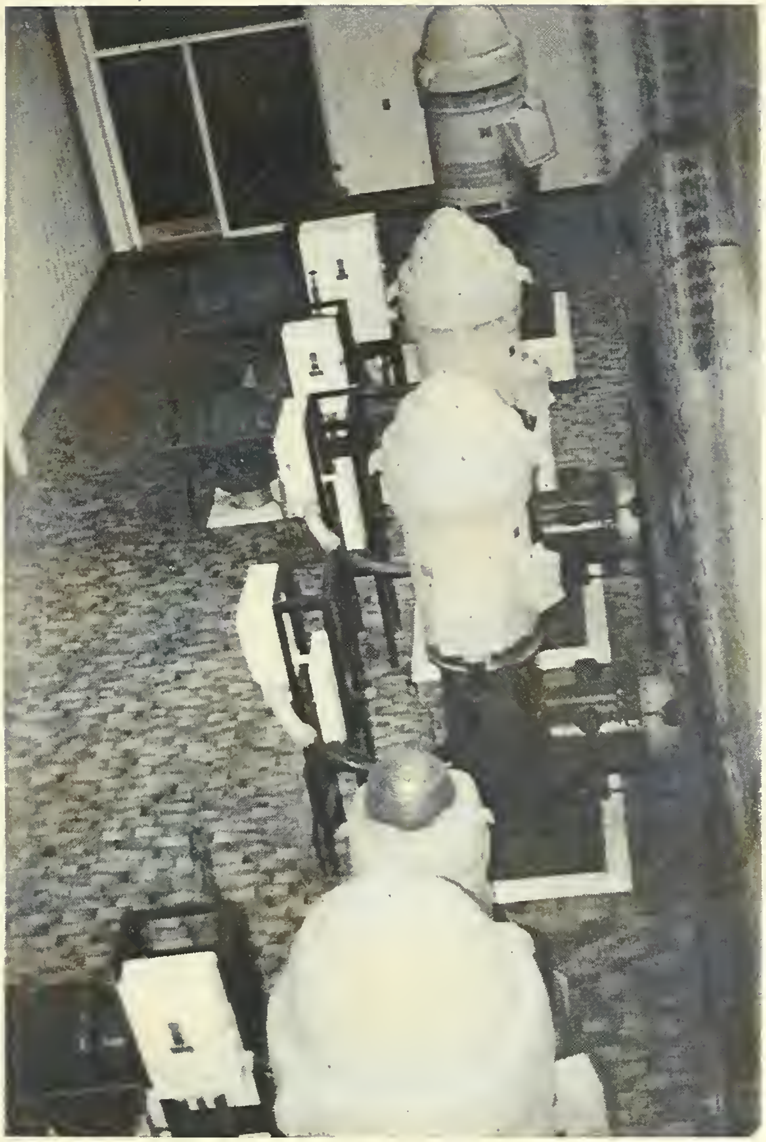
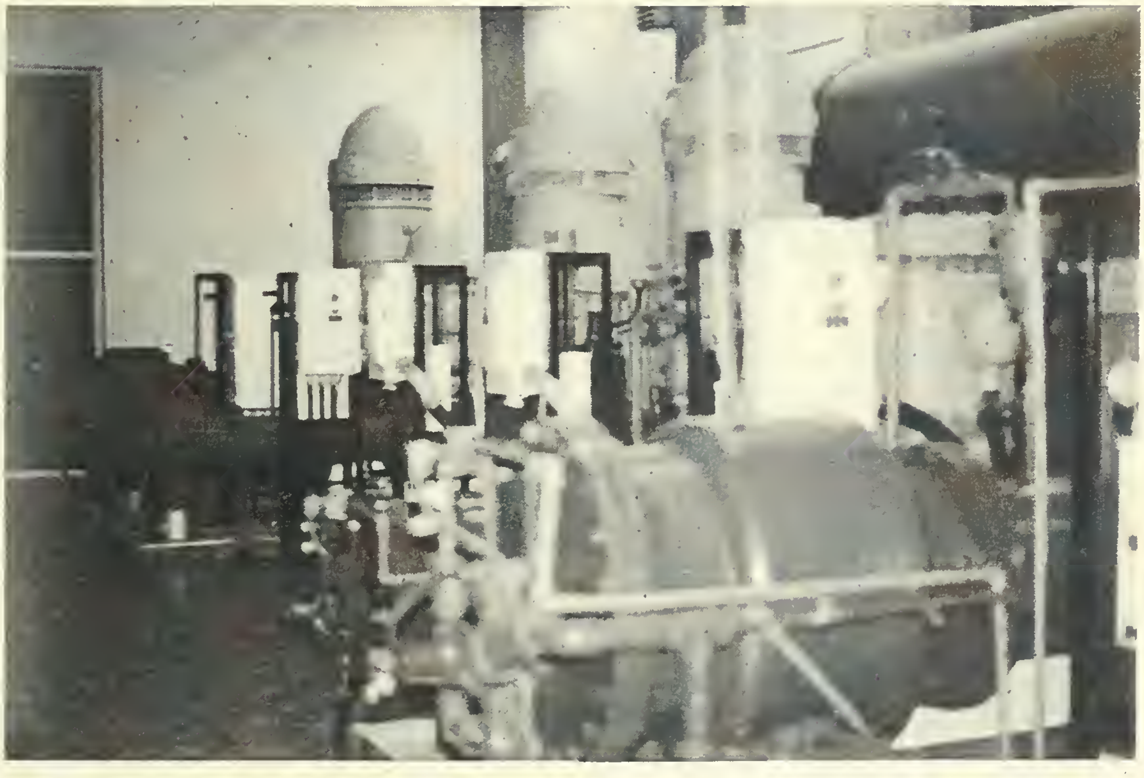
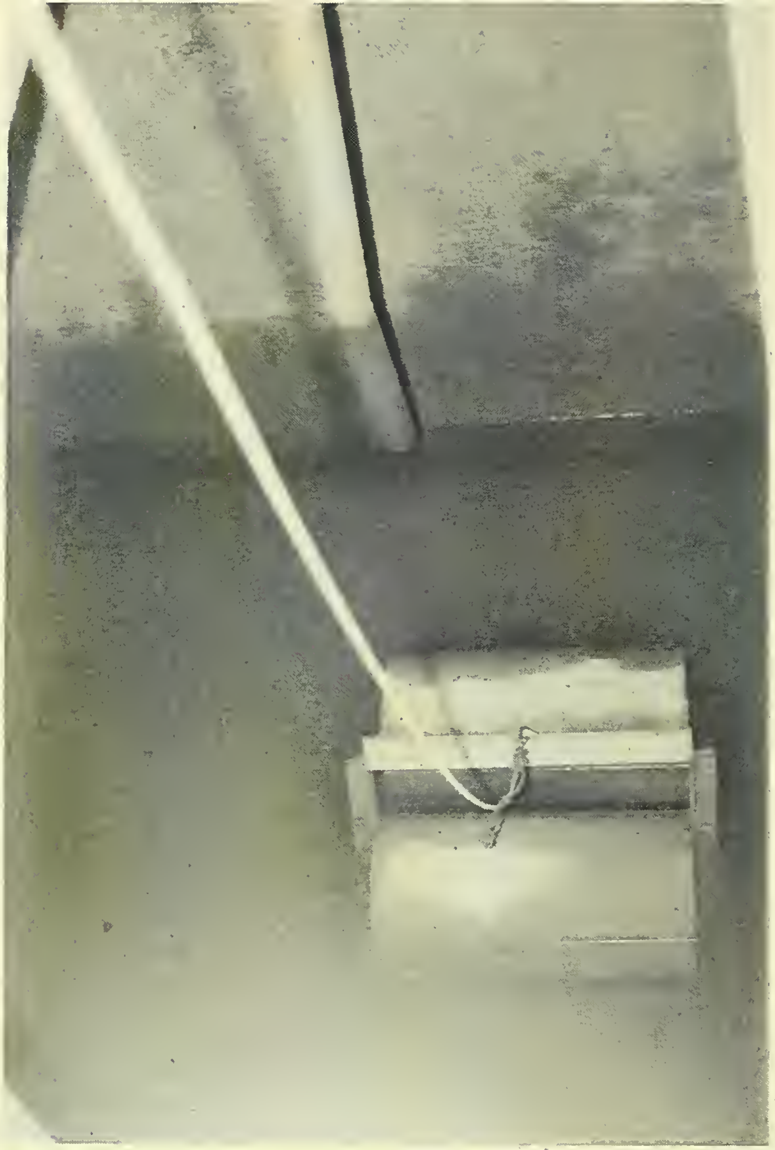


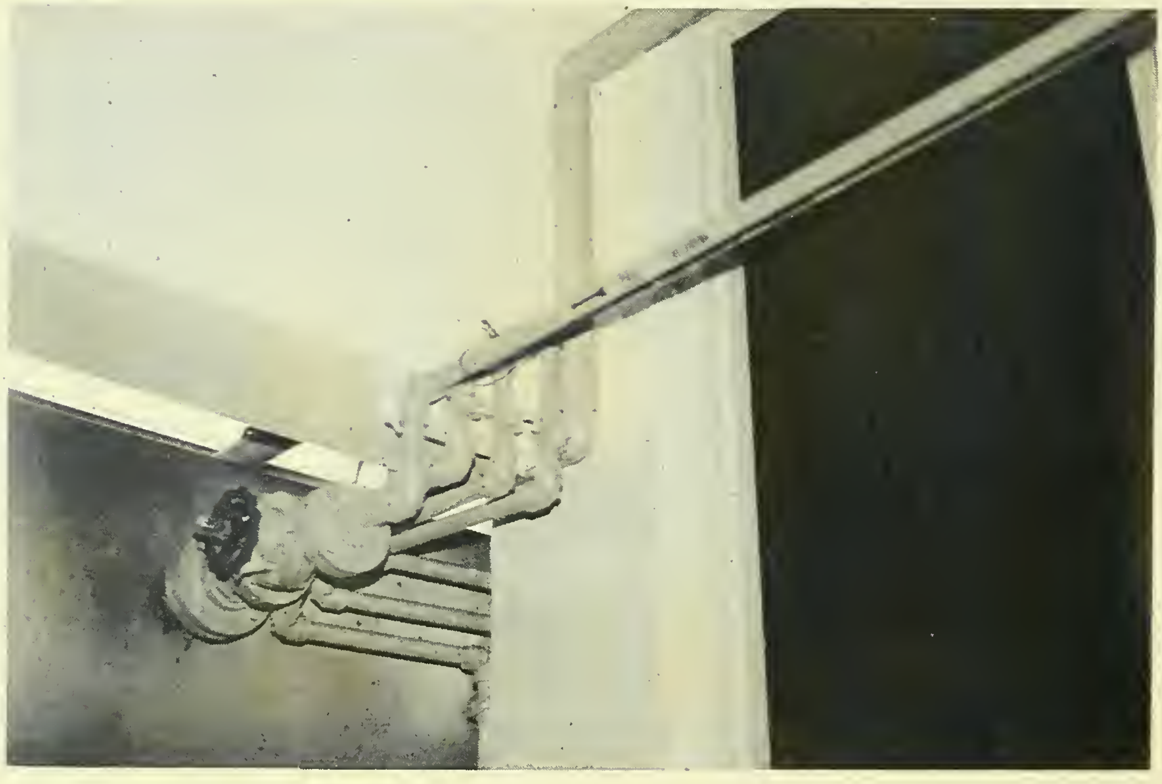
21. HIGH LIFT AND BACKWASH PUMP GALLE



22. HIGH LIFT AND BACKWASH PUMP GALLERY

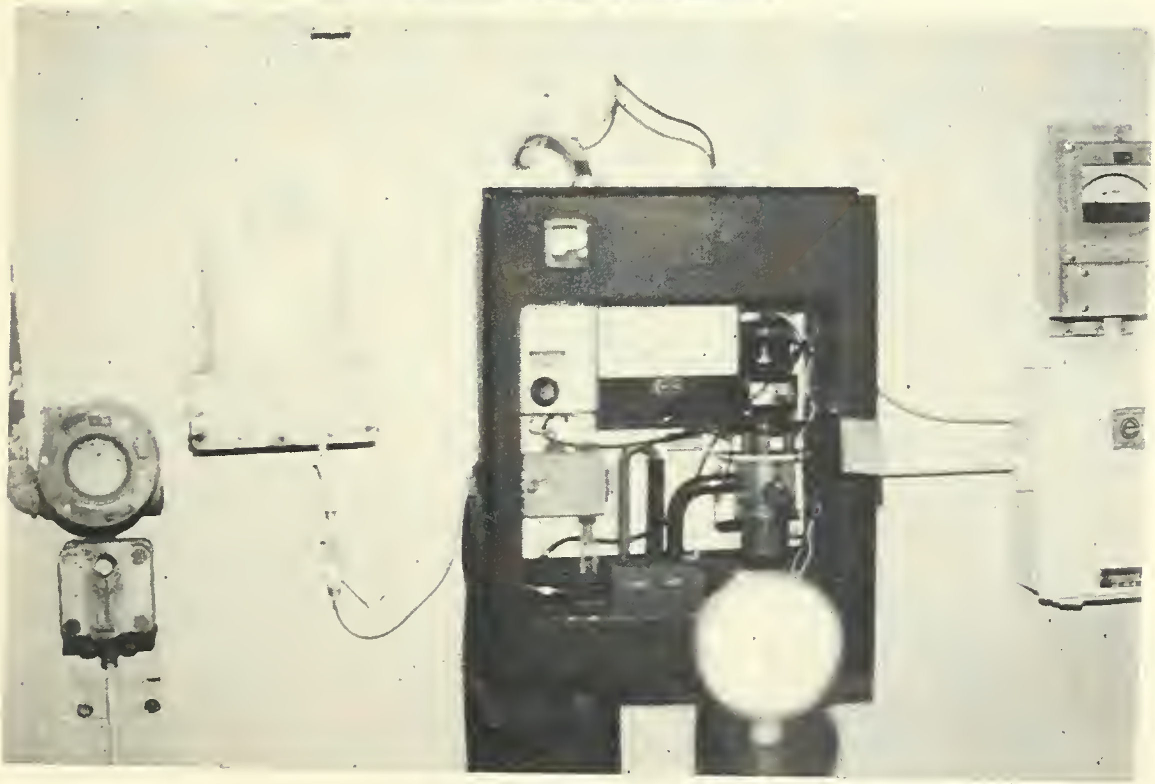


23. BACKWASH TANK
DECANT ARM

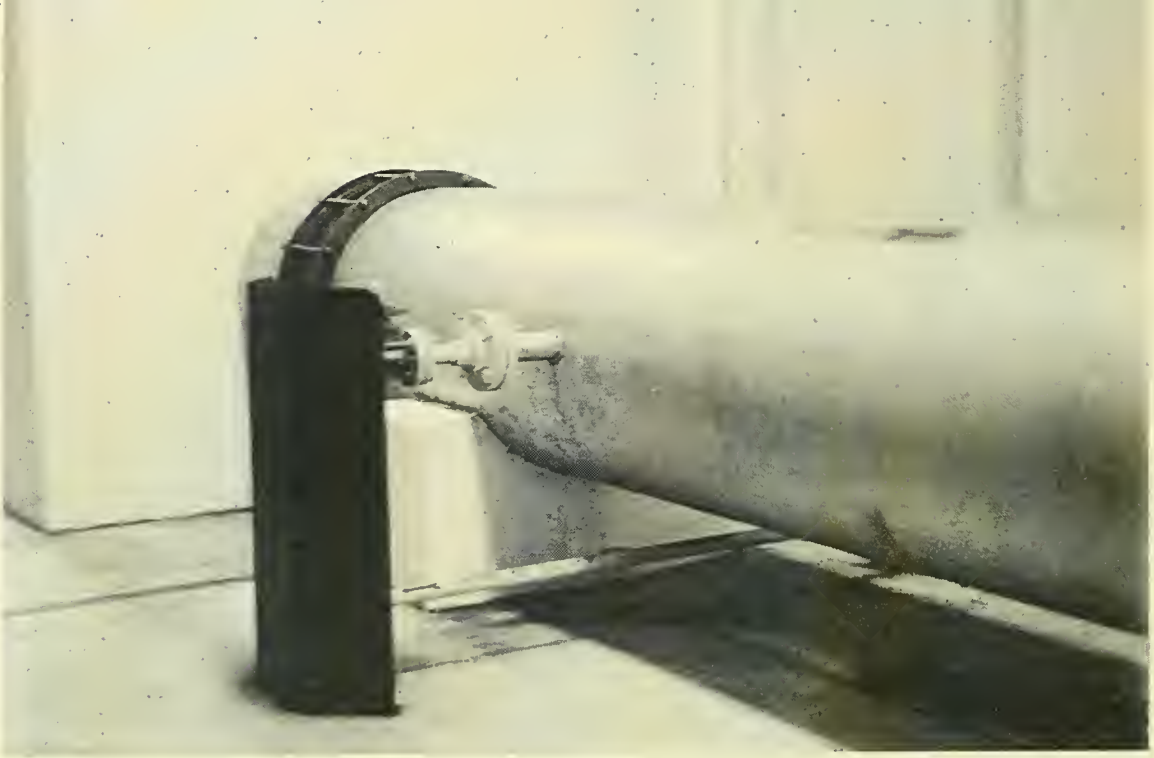


24. CHEMICAL PIPING

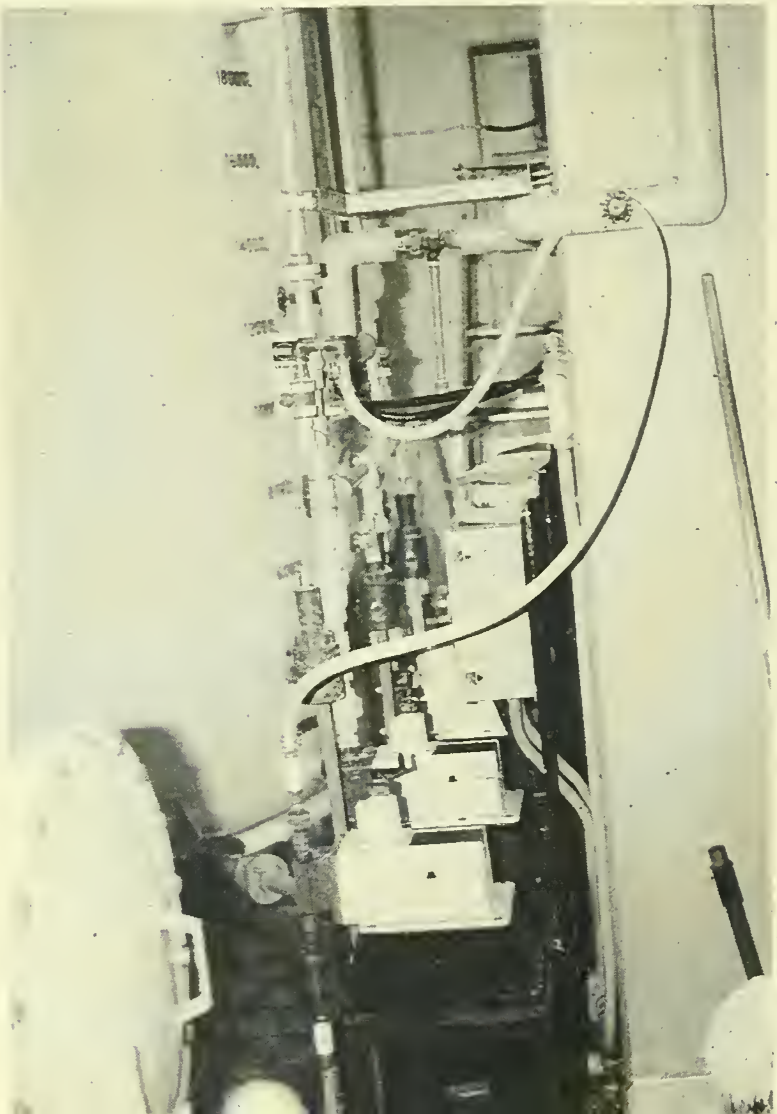
25. PRE, POST AND STANDBY CHLORINATORS



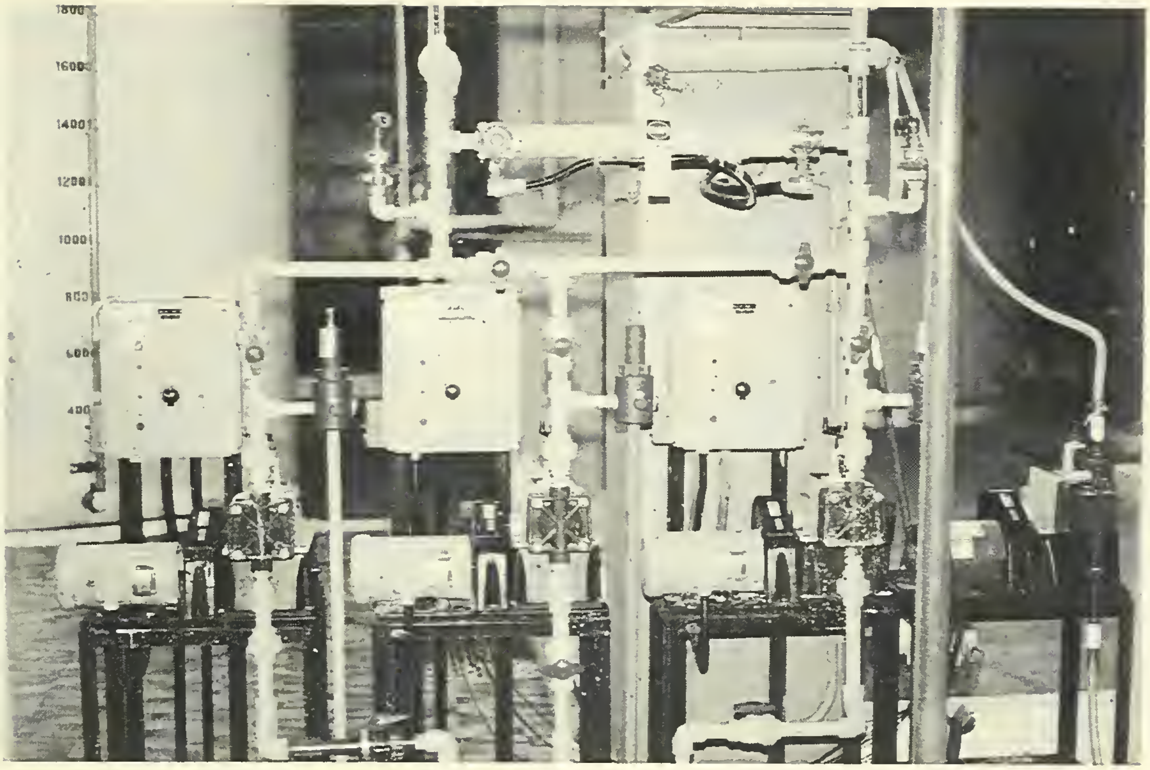
26. POST CHLORINE ANALYSER



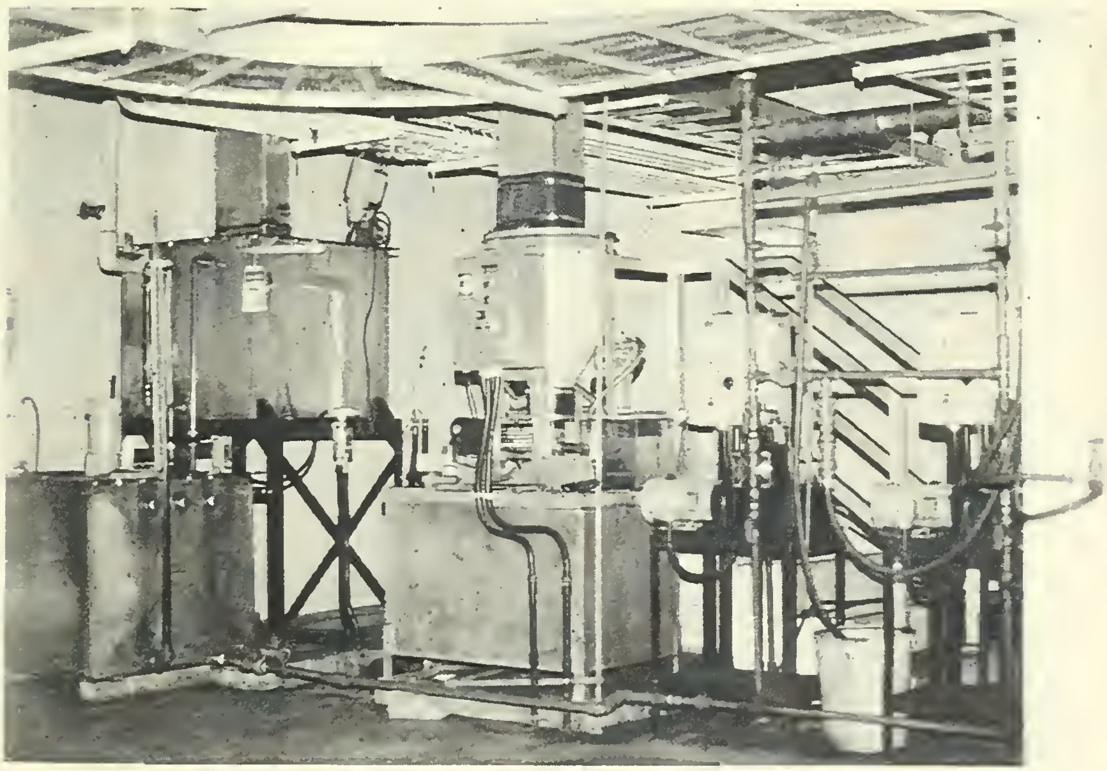
27. POST CHLORINE (TOUCH-UP) DOSING POINT



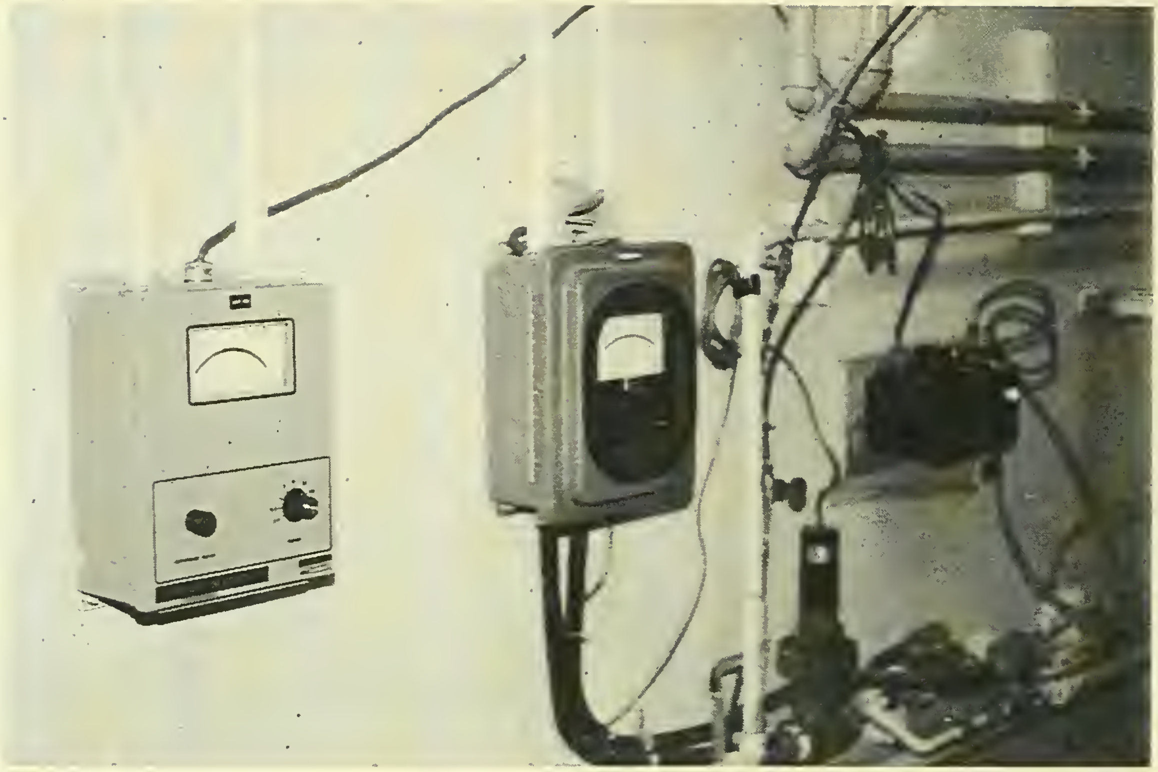
28. ALUM FEED



29. ALUM METERING PUMPS

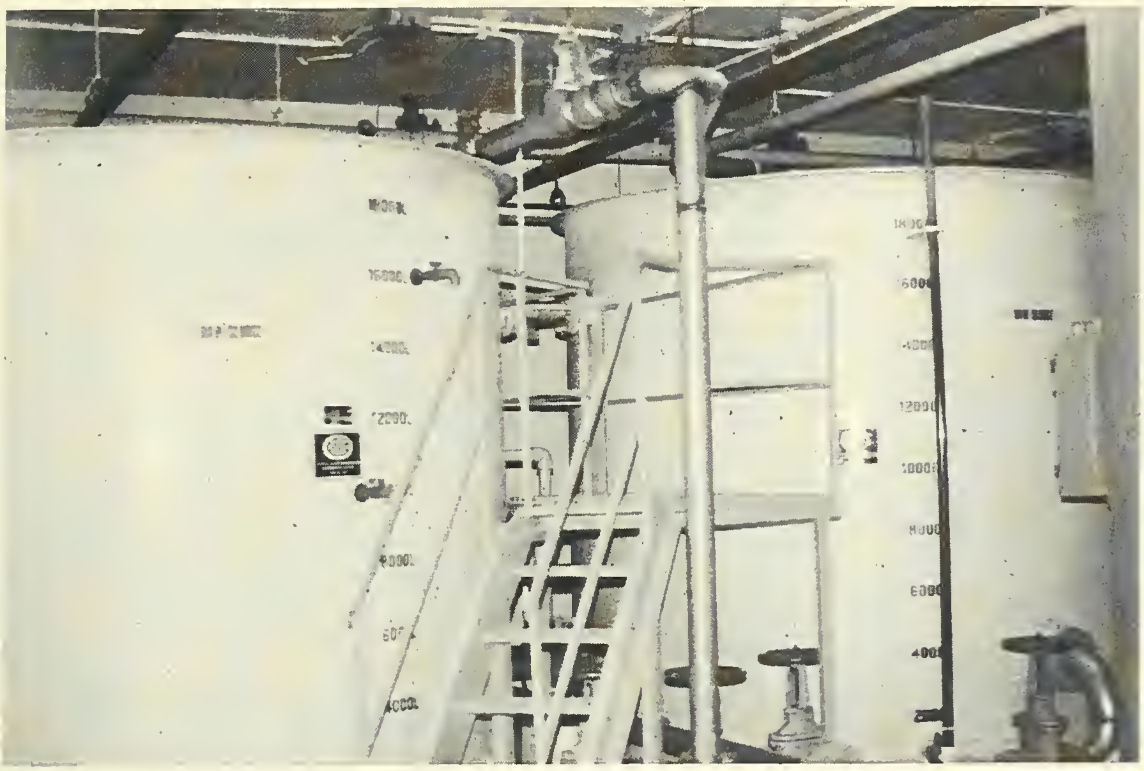


30. POLY, PAC AND SODIUM CHLORITE - CHEMICAL AREA

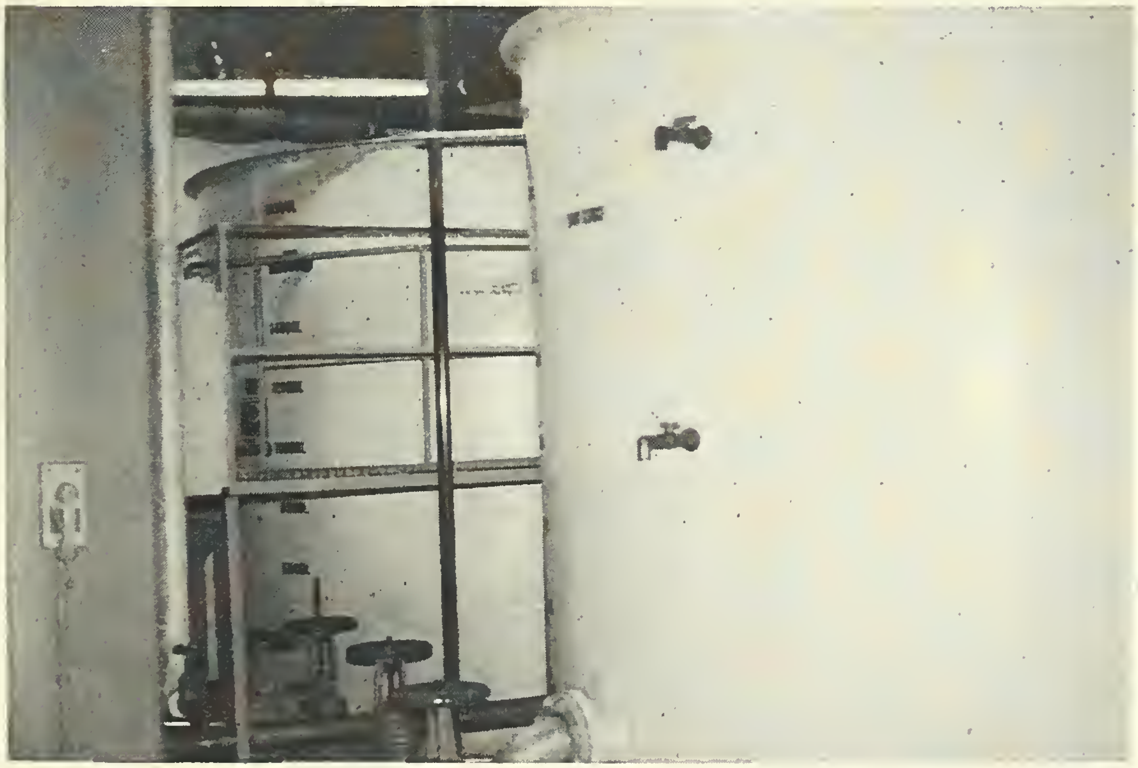


31. PLANT ANALYZERS

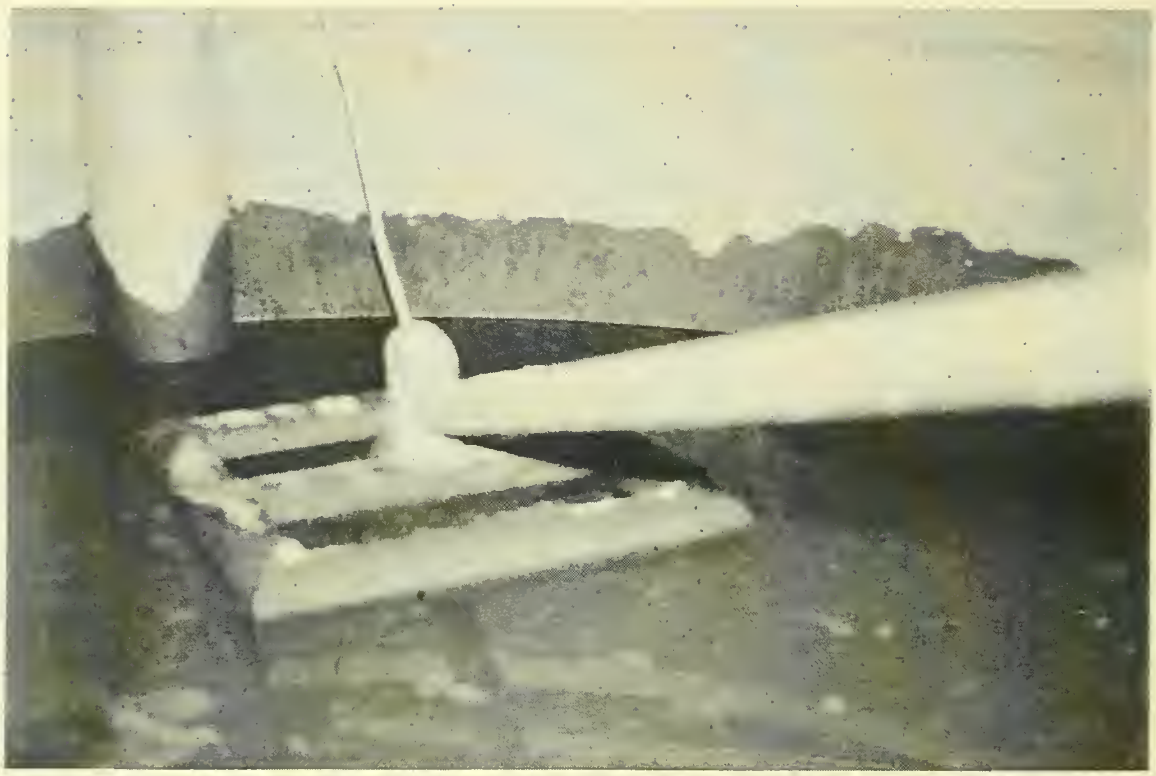
32. PAC ROOM



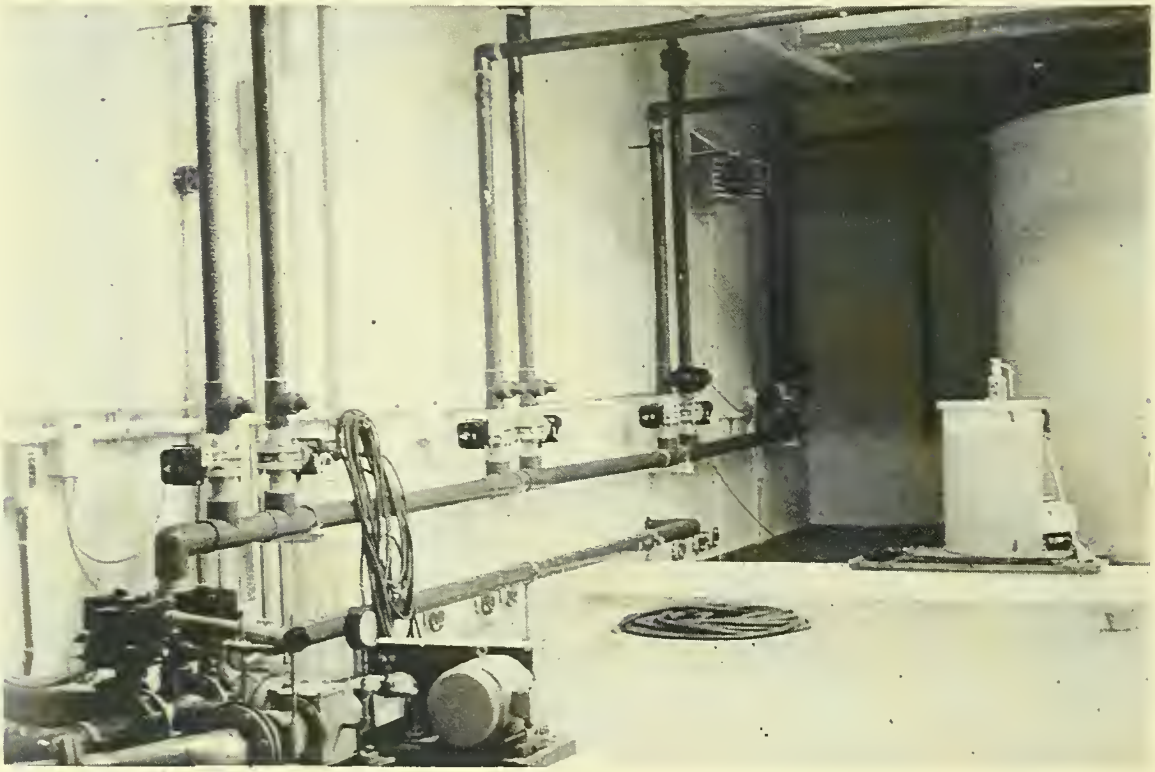
33. SLUDGE HOLDING TANKS



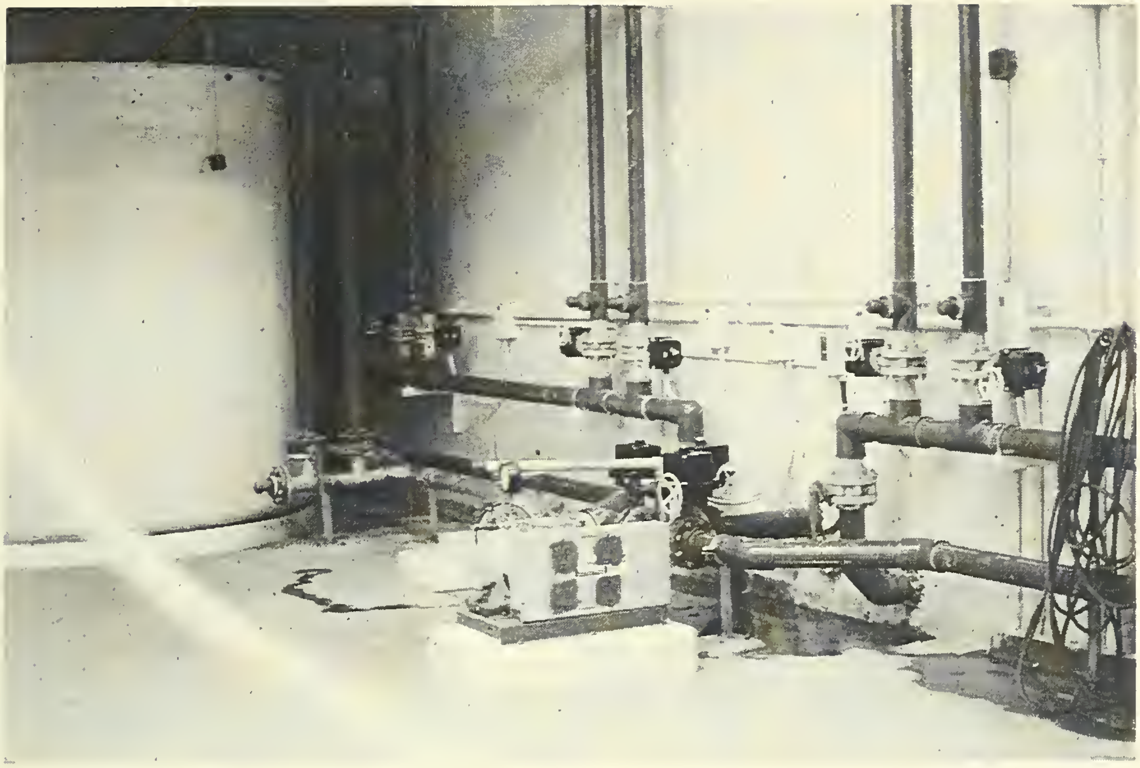
34. SLUDGE HOLDING TANKS



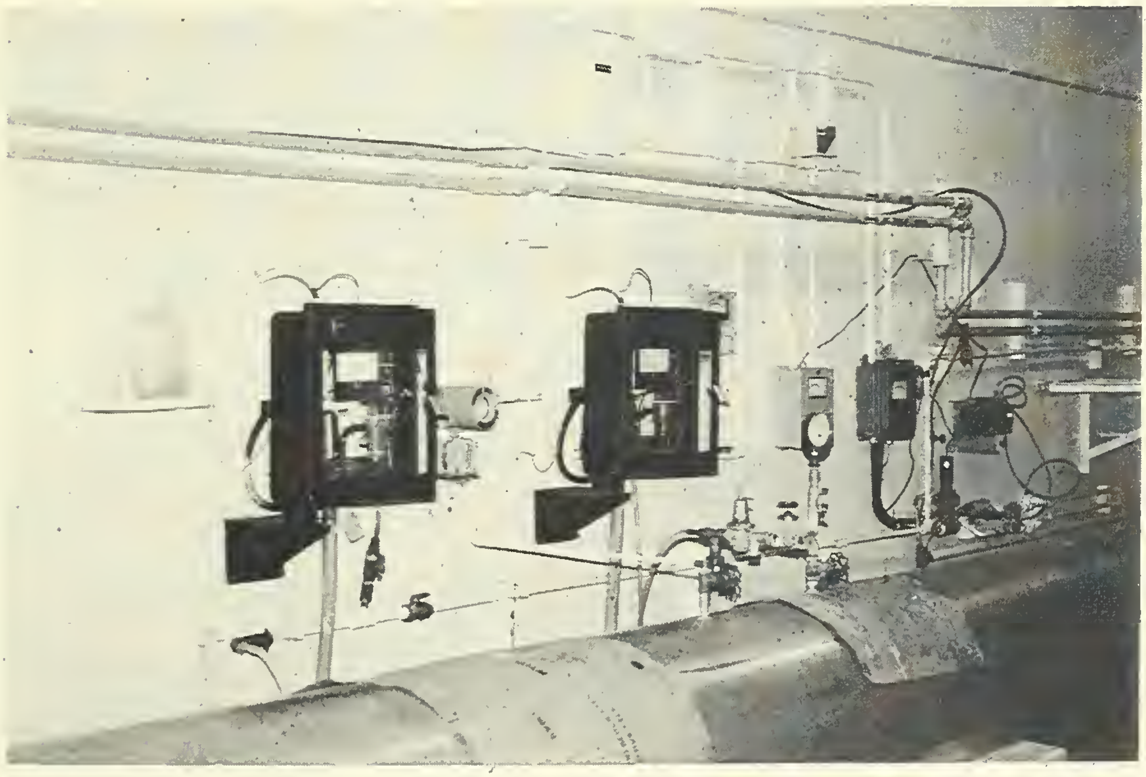
35. SLUDGE DECANT ARM



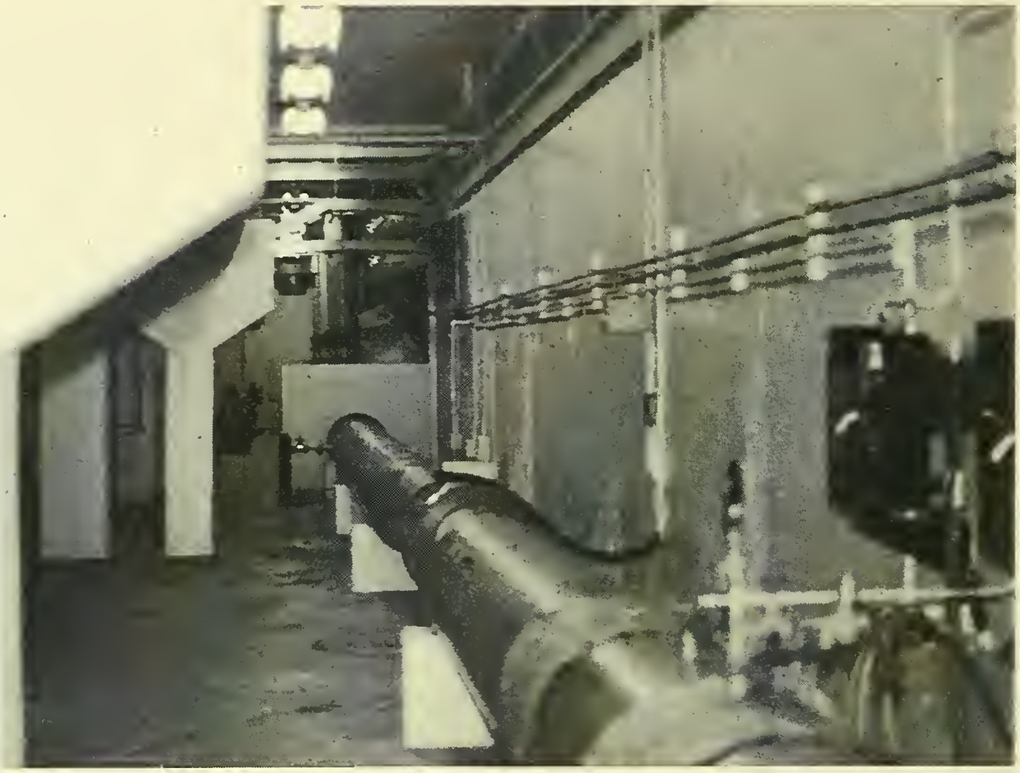
36. SLUDGE BLOWDOWN PIPING



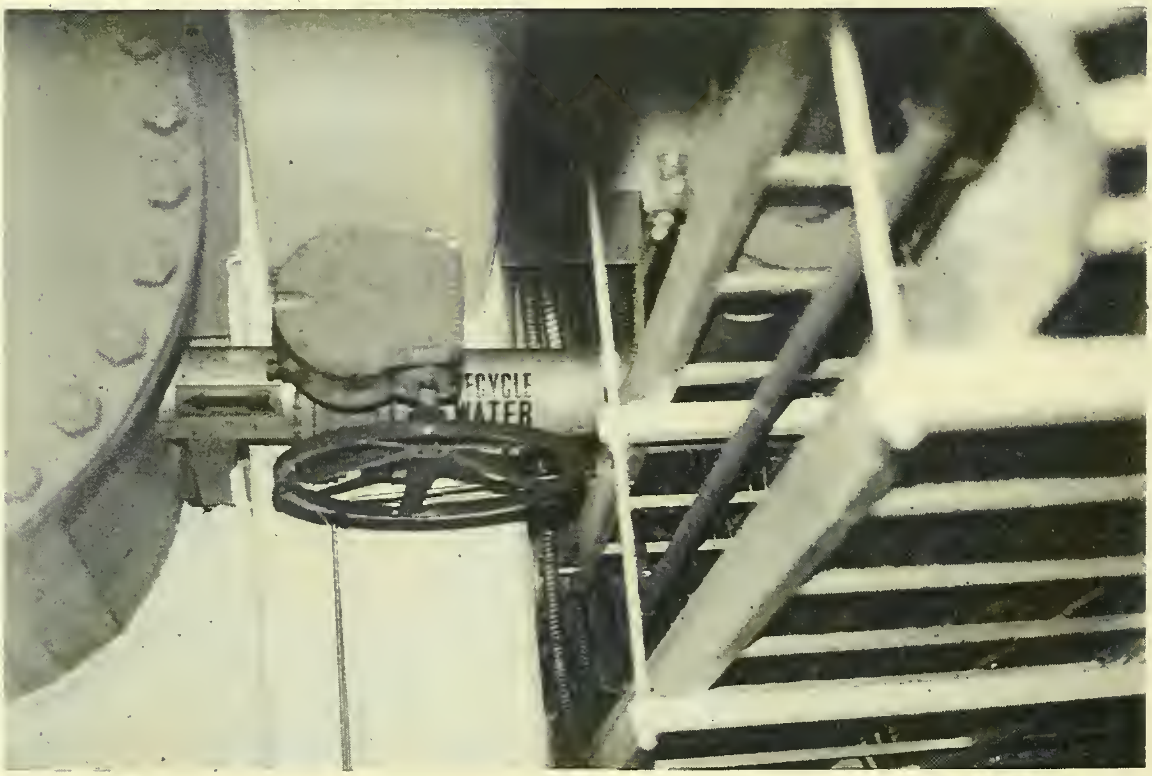
37. SLUDGE BLOWDOWN PIPING



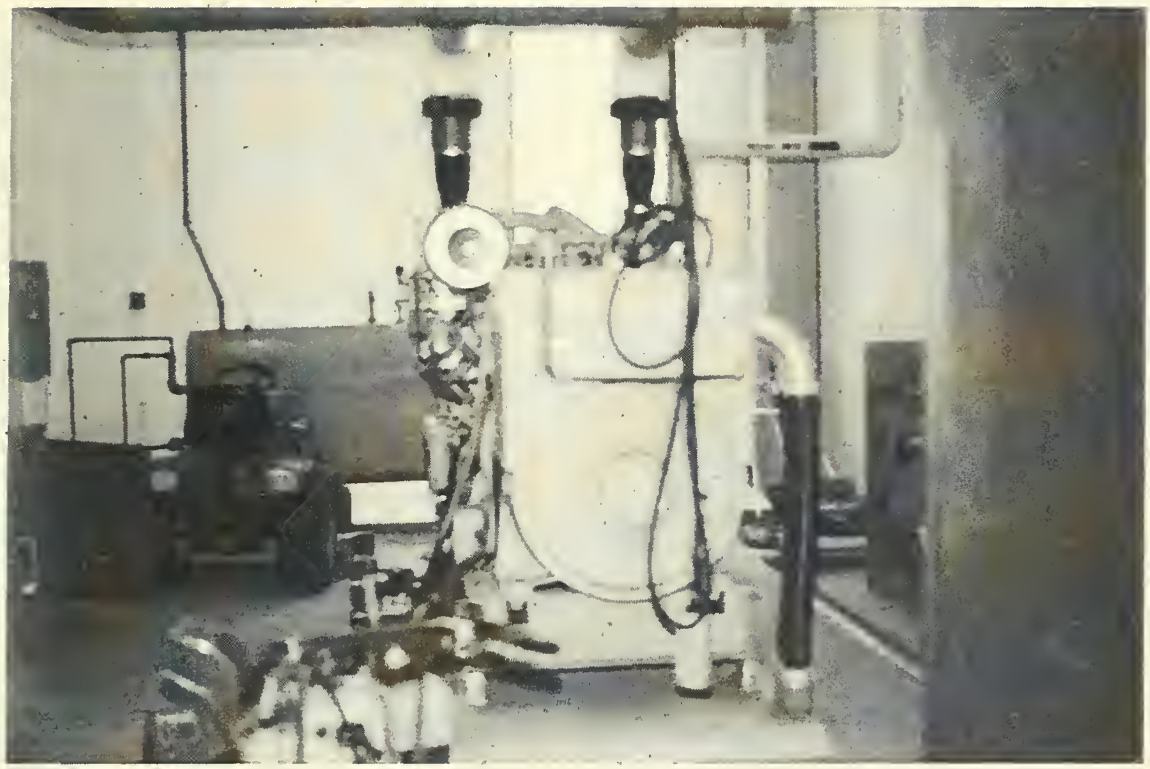
38. ANALYTICAL EQUIPMENT



39. PLANT DISCHARGE MAIN

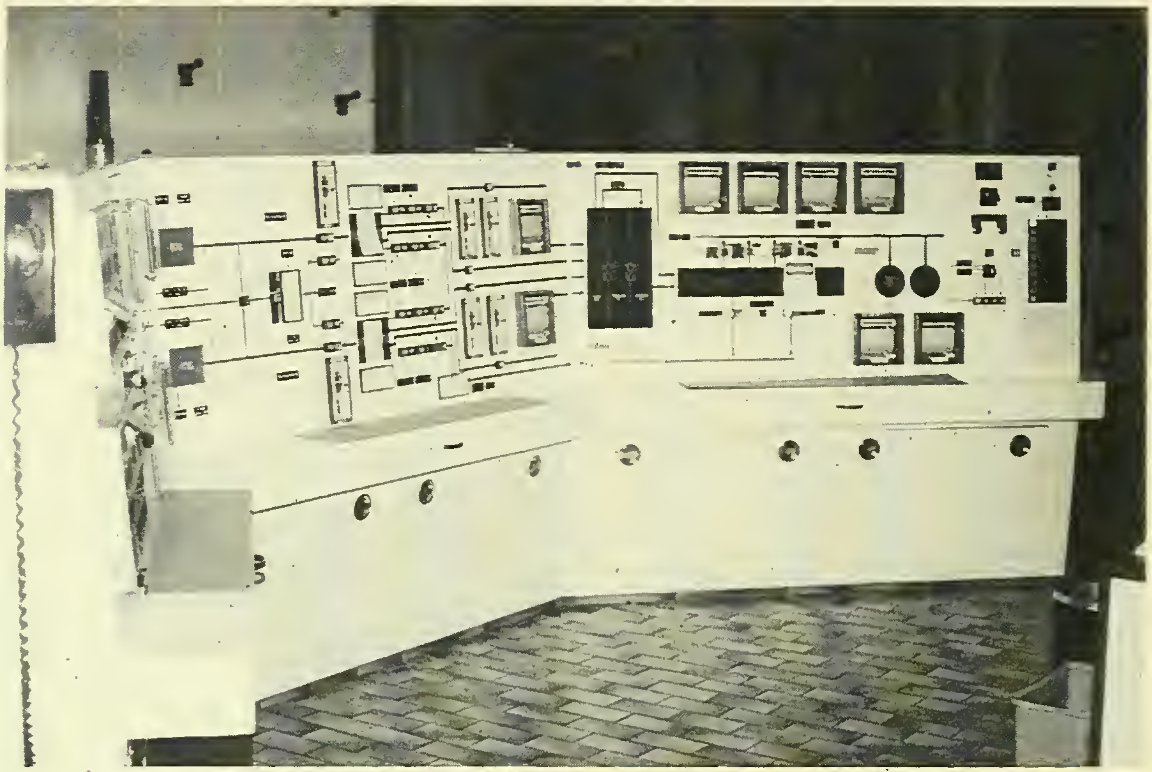


40. RECYCLE WATER PIPING

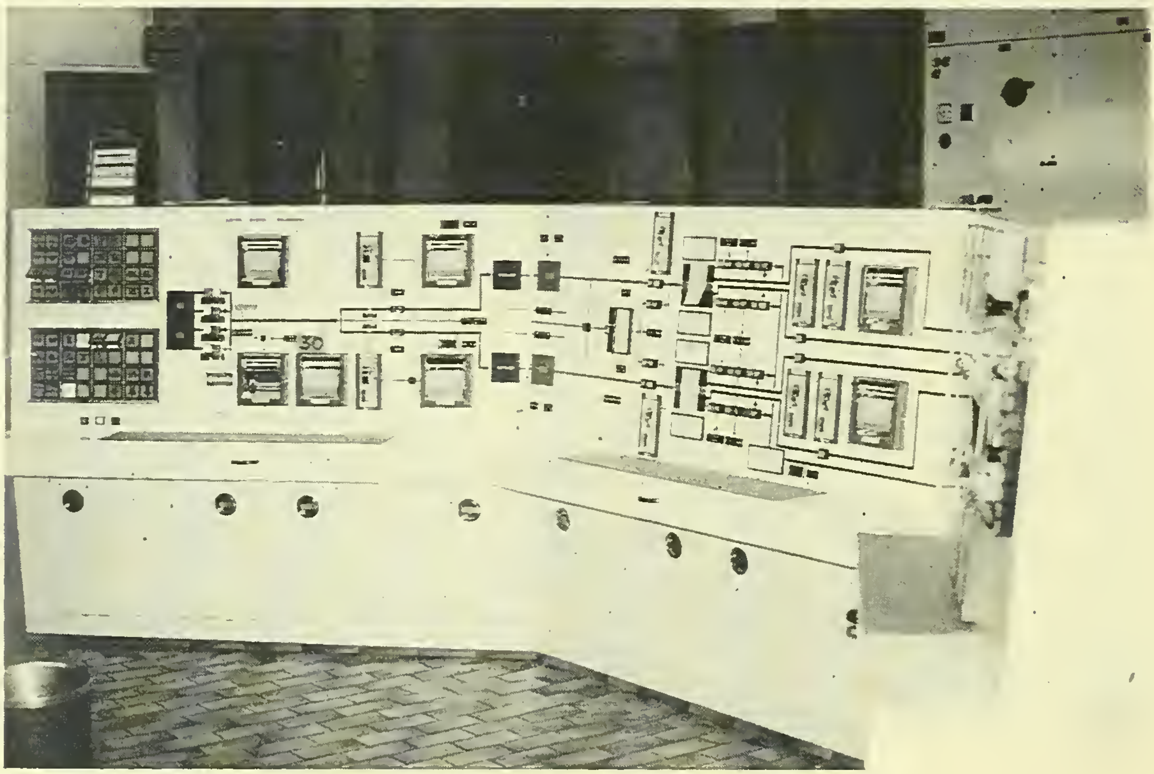


41. STANDBY DIESEL POWER

42. CONTROL ROOM



43. CONTROL PANEL



44. CONTROL PANEL

SECTION D - PLANT OPERATION

SECTION D. PLANT OPERATION

D 1. Description

a) General

The Rosehill water treatment plant was put into service in May 1980. The plant can operate either under the constant rate conventional treatment mode (ie. flocculation, sedimentation and filtration), or in the direct filtration mode without sedimentation.

The plant is staffed on a 24 hour per day basis. The treatment plant staff includes 4 full time operators on 12 hr shifts, with 3 full time and 2 part time (students) maintenance staff on 8 hr shifts.

b) Flow Control

The following is an overview of the flow control through the plant.

i) Raw Water

1. The decision to start and stop any low lift pump rests solely with the operator under normal operating conditions.

2. Decisions are made based on observations of reservoir water level trends as indicated by the high lift pump well level recorder.

3. Due to the large volume of reservoir storage response time by the operator is not critical, i.e. under high demand conditions, the maximum rise or fall rate of reservoir water level would be in the order of 1 metre per hour.

4. The pumps may be controlled from the MCC in the low lift pump pumping station or from the control console. The system is best suited for control from the instrument console or remote location.

5. Pumps will shut down immediately under:

   - Power Failure
   - Low Lift Pump Well Low Level
   - Thermal Overload.

6. In the event of failure of the telemetry system between the low lift pumping station and the water plant, the annunciator panel will indicate low lift telemetry signal failure. Any low lift pumps running will automatically shut down and be prevented from re-starting until the system is restored.

ii) <u>Pretreatment</u>

1. The flow rate control system is based on the concept of manually set constant rate filtration and is achieved by means of venturis and associated modulating control valves on the line to the flocculators, and on each of the lines from the filters.

2. Coarse adjustment of the plant flow rate is made by operator selection of low lift pumps. Fine adjustment of plant flow rate is achieved by manual adjustment of a valve controller that establishes a common flow set point to each of the two halves of the plant.

iii) **Filtration**

1. The filter inlet channel level in the plant provides the set point to the flow controller on the line to the flocculators to automatically maintain level stability.

2. The filter inlet channel level automatically overrides the master rate set point to the filter flow controllers to protect against dewatering the plant should the master rate set point exceed the capacity of the low lift pump(s) running at that particular time.

3. As the reservoirs near top water level, the operator must override the reservoir water level set point to each valve controller to minimize the frequency of plant shutdowns.

4. All controller outputs may be adjusted manually.

iv) **Plant Discharge**

1. High lift pumps may be controlled locally from the MCC which takes precedence over any other mode, or remotely via the operator's console. This enables the operator to manually initiate start and stop control outputs for any pump in any sequence.

2. The pumps may be controlled automatically from the Fort Erie South Elevated Tank level in an operator selected sequence and over adjustable level bands.

c) **Filter Backwashing Procedure**

1. Initiate backwash sequence under the following conditions:

(a) Backwash settling tank level is low, approximately 1.0 m. (If the level is high and a backwash sequence is initiated, the washwater will overflow to the lake when the tank level reaches 4.6 m.)

(b) Filter No. 1 (2, 3, 4) loss of head reaches approximately 2.0 m.

(c) Filter No. 1 (2, 3, 4) effluent turbidity deteriorates.

(d) To suit operator schedule.

2. Select desired backwash flow as follows:

(a) Select backwash rise rate in filter from operating experience. Guidelines shown on Figure 1 in Appendix C.

(b) Read raw water temperature.

(c) Enter graph on Figure No. 1 as shown and read backwash flow.

3. As a general guideline, set raw water flow controllers such that plant inflow does not exceed 40,000 m^3/d when 2 filters are taken out of service for backwashing.

Note: If the valve by-pass is closed, raw water inflow to filters undergoing backwash should be zero to prevent overflow.

4. Manual control of backwash sequence is as shown in Figure No. 2 in Appendix C.

Caution: Failure to follow the sequence can lead to flooding of the control room floor. To shut down the backwash sequence in the event of flooding, depress the backwash pump, off pushbutton.

The noted sequence is manually controlled at the instrument console.

Other levels of control of filter backwashing are:

- manual control at MCCs and valve equipment

The normal mode is operator initiation based on observations of headloss, effluent turbidity and time since the last backwash.

Automatic interlocks to prevent filter backwashing are:

- Power Failure
- High Lift Pump Well Low Level
- Starting two backwash pumps simultaneously
- Thermal Overload

d) <u>Chemical Dosage Control</u>

i) <u>Chlorine</u>

The pre-chlorination dosage is controlled manually and paced on raw water flow. The post-chlorination dosage is based on a compound loop system. Chlorine is dosed in the chlorine contact chamber directly downstream of the filters. A free chlorine residual of 0.10 mg/l to 0.40 mg/l is maintained at this location.

Due to seasonal variations, i.e. algae blooms, an increase in the chlorine dosage is required to maintain a minimum free chlorine residual.

ii) **Alum**

Dosages varied between 1.4 mg/l and 41.1 mg/l over the the study period with a monthly average range of 4.2 mg/l to 29.5 mg/l. Raw water quality changes are seasonally variable with higher turbidity during the winter months.

Jar testing was carried out at the Rosehill plant to determine an effective way to reduce the treated water turbidity. Various combinations of chemicals were used and are summarized in Section E.2. The results indicated that the most effective way to reduce treated water turbidity is a combination of Alum at a dosage of 10 mg/l with polyaluminum chloride (PACL) at 2 mg/l.

e) **In Plant Sampling and Monitoring**

Several physical and chemical water quality characteristics are specifically sampled and monitored at the water treatment plant. Several of these parameters are continuously sampled and monitored as listed below:

Parameter	Equipment	Locations
Temperature	Robertshaw Model T319 bi-metallic sensor	Raw water inlet to plant.
Chlorine Residual (free)	Fischer and Porter	Clearwell composite sample (free).
Chlorine Residual Plant Discharge (free)	Fischer and Porter	600 mm diameter plant discharge main.

Turbidity	Lisle-Metrix Model DRT-200	Raw water inlet to plant. Filters 1,2,3 and 4 effluent on 15 minute rotational basis.

The signals from the analytical equipment listed above are transmitted to the instrument console which logs the values on continuous chart recorders.

Grab samples can be obtained from many points within the plant. The plant laboratory is equipped with modern instruments as listed below:

- Digital weigh scale
- Microwave (for sludge concentrations)
- Hach 2100A Turbidimeter
- Wallace and Tiernan A-790 Chlorine Residual Titrator

Every four hours, free and total chlorine residuals are determined for Pre and Post Chlorination, and at the reservoir discharge location. A combined chlorine residual is also obtained at this latter location, where facilities exist for an additional chlorine"touch up" dose.

Also every four hours, turbidity measurements are taken at the following locations:

Raw Water
Settled water (East and West Clarifiers)
Longest filter run effluent
Finished water (leaving the plant)

One test of sludge density is performed on every shipment of sludge leaving the plant.

D.2 Operation and Process Concerns

The following observations have been made:

a) Pretreatment

Pre-Chlorination is practiced at the Rosehill plant. Chlorine solution is introduced at the 900 mm diameter raw water main upstream of the bifurcation into two 400 mm mains. During low flow periods, the chlorine solution continues along the 900 mm raw water main to the 400 mm leg that feeds the west side of the plant. It is suggested that the flow streamline drives the chlorine solution along the path of least resistance. Several solutions have been proposed as follows, although some have practical limitations:

- relocating the pre-chlorination point further downstream (as an example, after sedimentation).
- providing flow straightening vanes at the 400 mm diameter west leg in order to distribute the chlorine solution to the east side of the plant.
- provide a static mixer to induce adequate mixing at the present point of injection.
- open the connection between the two 400 mm lines ahead of the flocculators in order to try and permit further mixing to equalize the chlorine dosage.

A pre pH correction dosing point was provided for, near the same location as the pre-chlorination point. Pre pH adjustment has never been practiced since the plant was commissioned and probably never will be due to the adequate buffering capacity of the raw water. Even at higher aluminum sulphate dosages, pre pH adjustment probably will not be required at the plant influent.

The in-line blenders have been a source of considerable maintenance problems for the plant staff. They utilize packing around the shaft which leaks if undertightened, or if overtightened, results in shaft scoring. This ultimately provides high wear and excessive maintenance time for operational staff. At this time, both blenders have been removed from the system. Plant personnel state that there is no positive effect on the process using the in-line blenders. In fact, at the Niagara Falls Plant, Regional staff concluded after extensive testing over a one year period, that the in-line blenders produced a negative effect on coagulation.

The Regional operations staff have indicated that since the sedimentation tanks are equipped with tube settlers, there is no visible indication of the depth of sludge that is being carried in each tank. The deposition of sludge is not uniform throughout the sedimentation tanks. There is a greater depth of sludge close to the internal baffle wall and at the far ends of the tanks but this varies considerably over the entire tank. The use of a sludge level device will therefore require some experimentation to determine an optimum location.

Regional staff occasionally clean the tube settlers with high pressure water in order to remove lighter sludge that accumulates on the surface of the tubes.

It has also been reported by staff that parts of the tube settlers are appearing in the backwash tank intermixed with the sludge. It has been suggested that deterioration of the tube settlers from Ultra Violet Rays (U.V.) is the possible cause in making the tube settlers brittle.

Although sunlight is allowed to enter the settling area through windows on three sides of the settling tanks, it is considered doubtful that this is the cause. All exterior windows have a bronze outer covering which likely prevents the major components of U.V. light from penetrating through to the settling tank. Further, the surface of the tubes is approximately 1.5 metres below the top water level in the settling tanks, providing another hindrance to U.V. penetration.

After consultation with experts in the field of ABS molded plastics, it is suggested that square tube settlers are prone to stress cracking, especially about the corners. This is probably due to long term variations in water temperature, which causes the material to become more brittle. If the tubes are disturbed during the cleaning operations, deterioration will rapidly increase.

b) **Sludge**

Staff have commented on the fact that at times sludge accumulates in the middle of the backwash holding tank floor. The water scour available from the backwash drain header is insufficient to move the sludge towards the hopper and thus some manual cleaning is required.

c) **Turbidity Measurement**

Some problems with the measurement of filter effluent turbidity are due to the method of sampling that involves rotating measurement. Each filter incorporates a 13 mm diameter solenoid valve located on the sample line at the filter effluent header. The turbidity sequencer, located in the main control panel, selects the filter to be analyzed. The sample line from each filter to the turbidimeter may be too long such that the sample analyzed is not representative of actual performance. A more appropriate arrangement for this type of sampling method would be to use a four port type solenoid located close to the turbidimeter. A better arrangement would be to use a separate turbidimeter and recorder for each filter.

The Lisle Metrix Model A72 turbidimeter units experience severe condensation problems during certain times of the year. The Region has corrected some of the condensation problems by remounting these units on plywood backboards away from cold surfaces. It is generally considered, however, that other makes of turbidimeter do not suffer from these problems.

d) **Filters**

The filter rate flow control valves (G.A. angle type) exhibit excessive wear on the bottom of the piston. This problem has been discussed with the manufacturer for possible remedial action. It is also noted that during a power failure, only two of the four filter rate flow control valves are powered through the diesel generator. This is a limitation during high plant production. Since the valves are powered by 120 volts AC, rewiring of the two filter rate controllers which do not have backup power would be fairly simple.

e) **Chemical Dosing**

The Region has modified the originally installed and subsequently disused sodium chlorite dosing system to a powdered activated carbon (PAC) system. A makeshift plywood structure has been provided next to the workshop area in order to contain carbon dust.

Reasonable results have been achieved with up to 11 mg/L, but generally much less is used. The PAC dosing point is only 1.8 metres from the addition point for chlorine. At the plant rating of 50,000 m^3/d this provides approximately 2 seconds of contact time. The possibility of finding more contact time ahead of the present chlorine dosing points inside the plant is very limited. It has been suggested that relocation of the chlorine dosing points to the settled water channel would create more contact time for PAC.

The Region has also experimented with the use of polyaluminum chloride (PACL-Sternpac) in lieu of aluminum sulphate as a primary coagulant (see Table 2.1). It has been reported that PACL is particularly effective in cold water, i.e. below 4^{o}C, when the addition of more alum is generally required. In January 1986 (see Table 2.1), 13.8 mg/L of alum were used at a temperature of 1^{o}C. In similar temperatures in February 1986 only 1.7 mg/L of PACL was required. Section E1d. of this study contains details of jar testing that was conducted utilizing PACL, alum and a combination of PACL and alum to find the relative effectiveness of these chemicals as the coagulants.

The Region has calculated that the PACL costs approximately 30% more than Alum. However, major savings can be achieved in the handling of less sludge (approximately 144 percent less).

f) **General**

The Ministry of the Environment study team have commented that the Rosehill plant would be ideal for a streaming current detector study, since the plant is divided into two equal halves, hydraulically and in process. It would therefore be possible to monitor results with and without the use of a streaming current detector.

SECTION E PLANT PERFORMANCE

SECTION E. PLANT PERFORMANCE

E.1 Turbidity

a) General

Of all the characteristics which give an indication of poor water quality, turbidity is considered as one of the most important. It has been shown in many studies that the particulates responsible for turbidity can harbour bacteria and other hazardous material and shield them from disinfection. It is for this reason that water treatment in Ontario requires the treated water to have a turbidity of less than 1 NTU and preferably as low as possible. Seasonal variations in the turbidity of a water supply impose requirements on a water treatment plant design in order for a plant to achieve all year round effluent of low turbidity.

The water through the Rosehill Water Treatment plant currently undergoes pre-chlorination, coagulation, flocculation, settling, filtration and post chlorination prior to being discharged into the distribution system. Figure 4a shows the seasonal variations in the turbidity levels of Lake Erie in the vicinity of the water treatment plant. Figures 4b and 4c, showing the treated water turbidity, indicate that significant amounts of turbidity are removed by the treatment process. It can be seen that the highest raw water turbidity readings occurred in the winter months of December and January. During these months, the turbidity is reduced considerably.

Prior to December 1985, alum alone was used as a coagulant for water treatment, and it can be seen from Table 4d that the treated water turbidity was usually higher during the winter months. This is consistent with a less complete flocculation process due to the lower water temperature which in turn leads to less efficient particulate removal. However, after March 1986, the use of polyaluminum chloride was implemented in conjunction with alum, and following a brief readjustment period, the turbidity levels became more consistent. During the months of December 1986 and January 1987 no variation in treated water turbidity was observed. From the period of April 1986 to February 1987 the average turbidity of the treated water was 0.27 NTU.

b) **Sampling System**

The turbidity of the raw water is measured continuously by a Lisle Metrix Model DRT-200 turbidimeter. The turbidity of the effluent from each of the four filters is measured on a 15 minute rotational basis also with a Lisle Metrix Model DRT-200. The results from these instruments are continuously recorded. Additional results are obtained from grab samples analyzed by a Hach 2100A laboratory turbidimeter.

Readings taken during the Drinking Water Surveillance Programme (DWSP) in October 1985 found the turbidity readings of the treated water to be similar to that of the plant reading.

c) **Particulate Removal Efficiency**

Concerns about the method of sampling the effluent from the four filters have been discussed in Section D.2. The available results of the turbidity readings of the raw and treated water show that the plant obtains a particulate removal efficiency of between 87 and 99%. The average reading of approximately 0.3 - 0.4 NTU is obtained during normal operating conditions during the last 3 years. (see Figures 4a - c).

d) **Treatability Testing**

Jar tests performed on the raw water obtained at the intake of the Fort Erie treatment plant showed that water with a turbidity of 4.2 - 7.0 NTU and at a temperature of 21^{o}C can be effectively treated to reduce the turbidity to low levels. A tabulation these results is shown in Table 4E.

The jar testing results can be summarized as follows:

FORT ERIE PARTICULATE REMOVAL PROFILE

1986 RAW WATER TURBIDITY

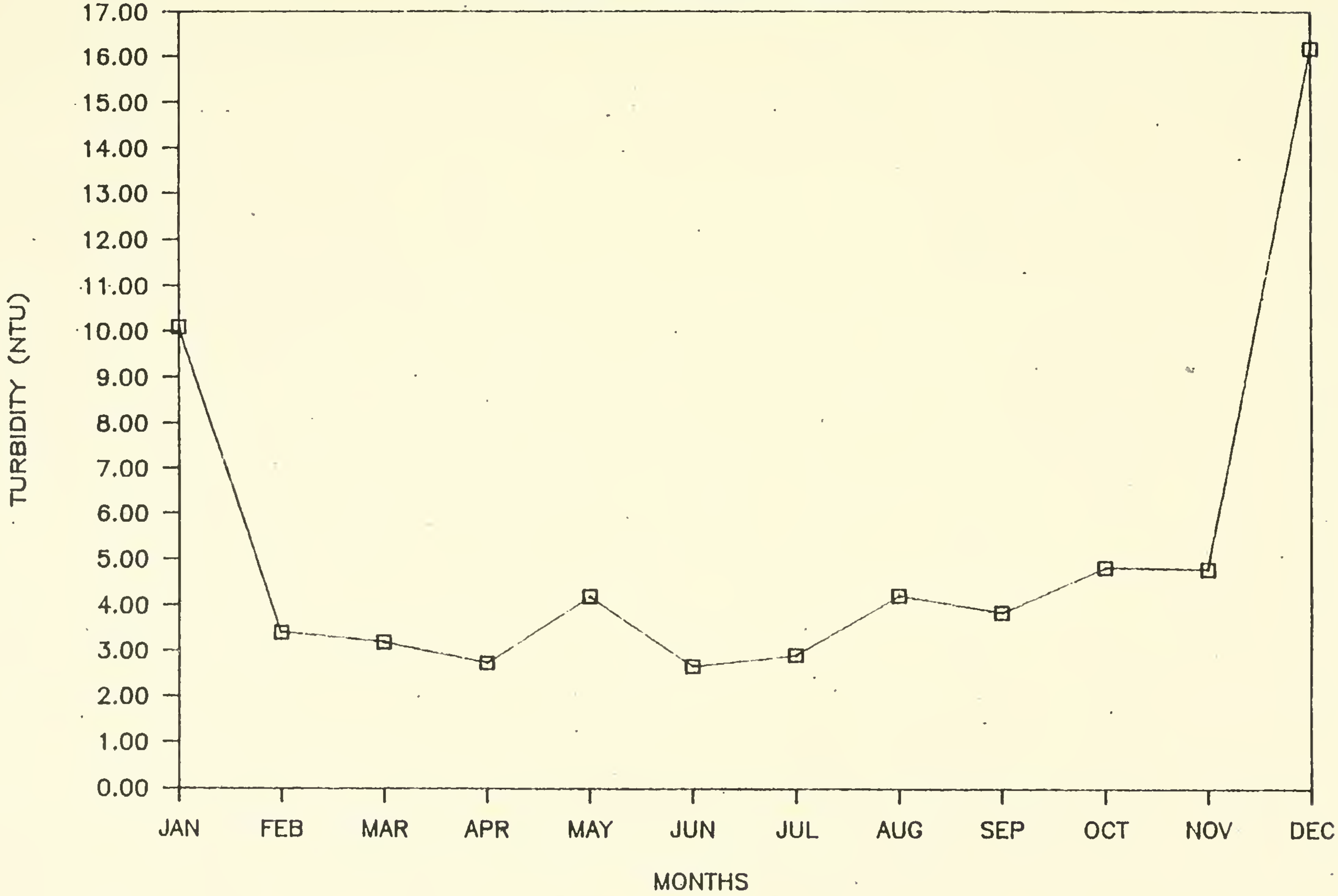


FIG. 4a

1986 TREATED WATER TURBIDITY

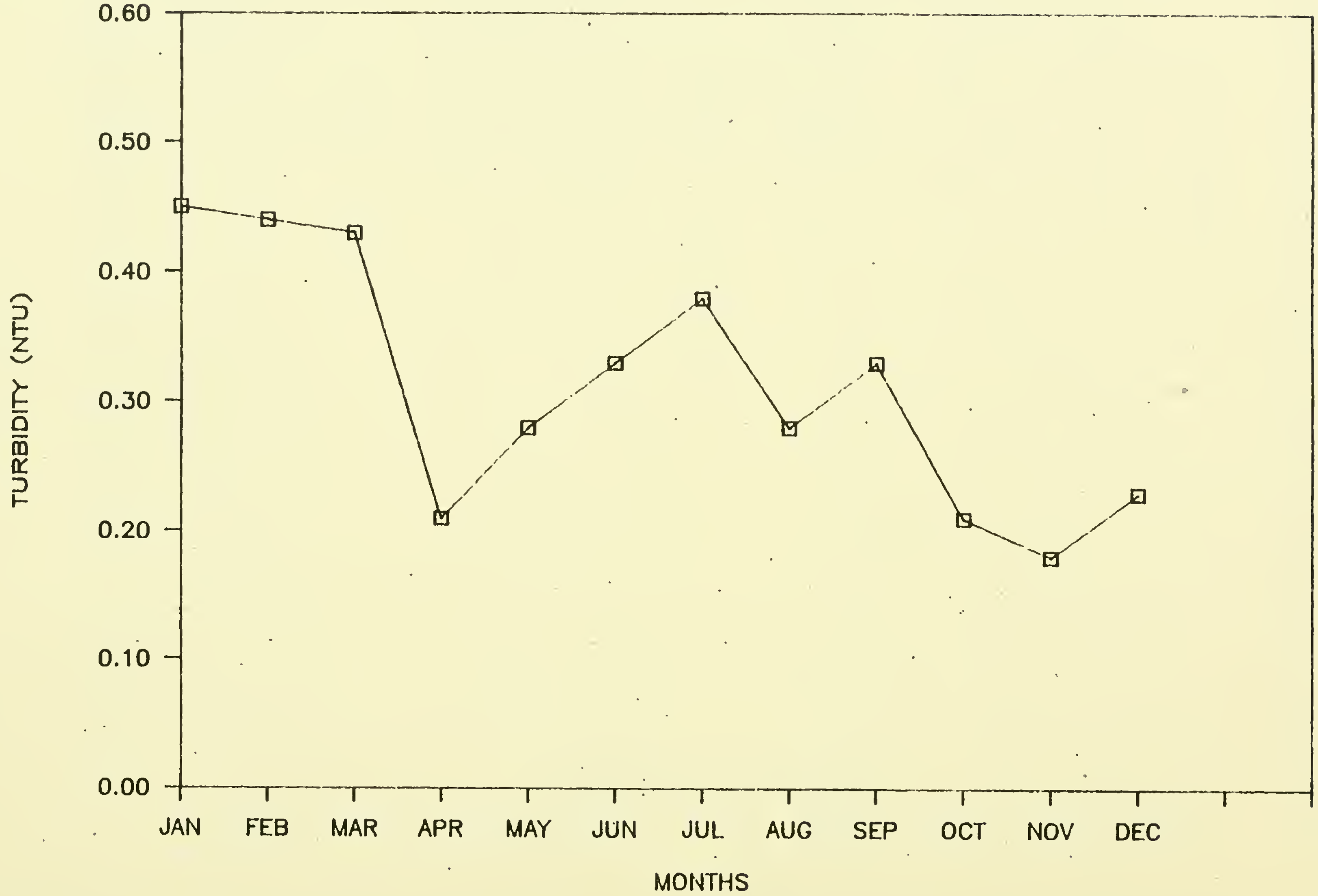


FIG. 4b

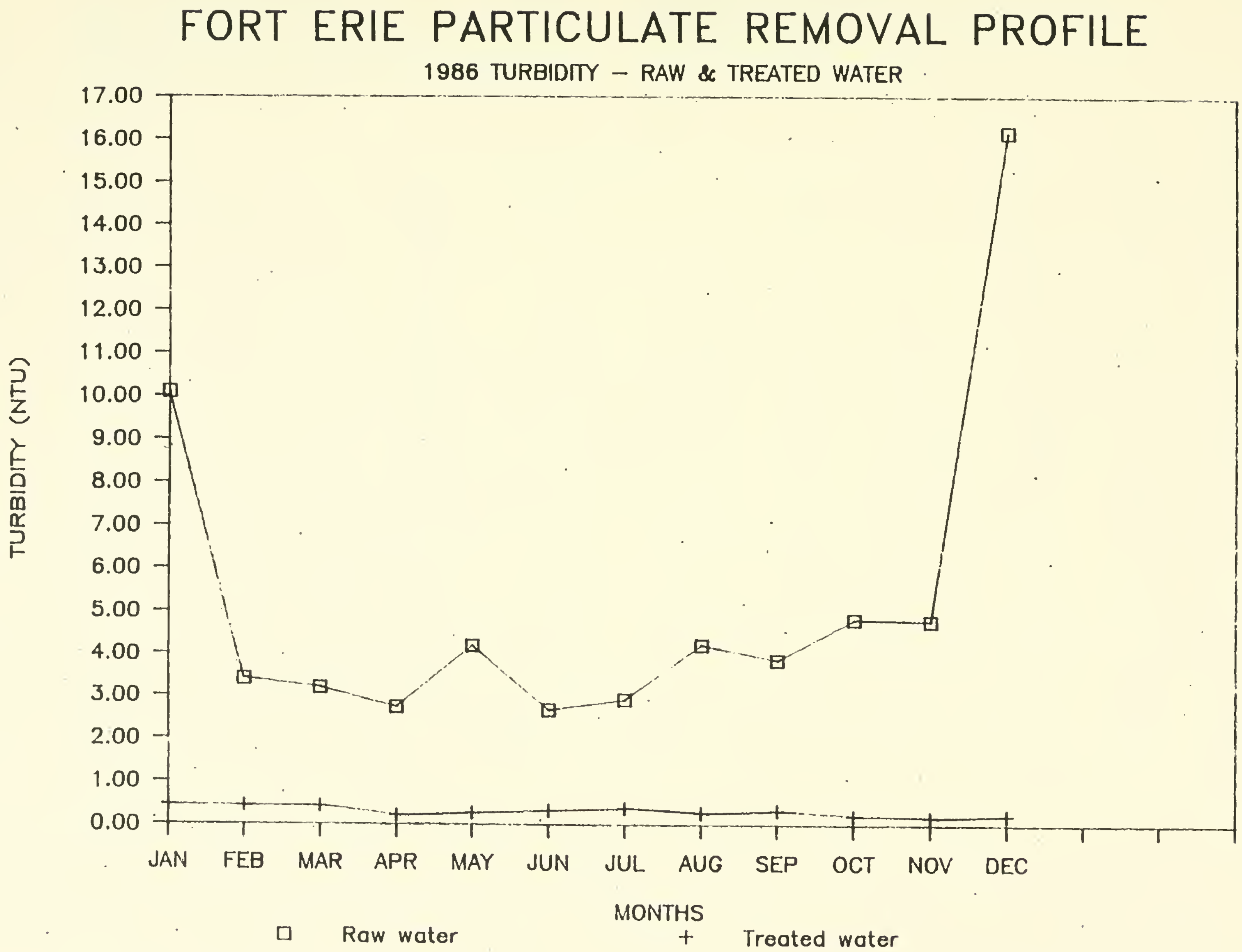

FORT ERIE PARTICULATE REMOVAL PROFILE
1986 TURBIDITY – RAW & TREATED WATER
TURBIDITY (NTU)
17.00
16.00
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
MONTHS
Raw water
Treated water

FIG. 4c

PRINTED 03/18/87

Table 4D

ROSEHILL WATER PLANT
ALUM/POLY ALUMINUM CHLORIDE PLANT TEST

		AVERAGE RAW WATER TEMP. 0 C	TURBIDITY AVERAGE RAW N.T.U.	TURBIDITY AVERAGE TREATED N.T.U.	TURBIDITY % REDUCTION	RAW WATER FLOW M3		ALUM USED LITRES	ALUM COST $/ML	PAC USED LITRES	PAC COST $/ML	SLUDGE PRODUCTION LIQUID VOLUME M3		SLUDGE PRODUCTION % TOTAL SOLIDS	SLUDGE PRODUCTION SOLIDS VOLUME M3		SLUDGE PRODUCTION MONTHLY COST $	
1985	JAN	1.4	16.6	0.26	98.4	377,130		12,780		0		100.1		6.20	6.2		268.75	
	FEB	0.1	5.0	0.30	94.0	347,850		7,703		0		172.9		10.30	17.8		419.25	
	MAR	0.1	4.3	0.40	90.7	398,960		5,513		0		145.6		5.92	8.6		682.00	
	APR	0.4	4.7	0.34	92.8	372,640		3,546		0		77.4		5.77	4.5		365.50	
	MAY	7.5	4.7	0.23	95.1	490,371		6,088		0		127.4		4.50	5.7		290.25	
	JUN	14.8	4.4	0.23	94.8	544,058		5,971		0		327.6		4.47	14.6		763.75	
	JUL	18.0	3.4	0.19	94.4	735,987		8,000		0		309.4		6.20	19.2		576.75	
	AUG	22.1	2.5	0.21	91.6	788,739		8,473		0		127.4		10.82	13.8		311.75	
	SEP	20.4	2.5	0.33	86.8	482,444		4,070		0		45.5		26.20	11.9		107.50	
	OCT	15.0	4.1	0.27	93.4	436,538		3,890		0		218.1		15.49	33.8		537.50	
	NOV	9.7	5.4	0.36	93.3	411,332		7,472		0		91.0		5.96	5.4		215.00	
	DEC	3.6	31.9	0.28	99.1	408,280		18,279		0		737.0		11.39	83.9		1,741.00	
1986	JAN	1.0	10.1	0.45	95.5	447,703		8,140	3.17	231	0.99	618.8		19.96	123.5		1,338.25	
	FEB	1.0	3.4	0.44	87.1	416,450		0	0.00	1,508	1.40	72.8	2,898.3	5.50	4.0	329.1	167.20	7,046.45
	MAR	0.9	3.2	0.43	86.6	434,300		3,194	2.15	867	1.31	45.5		4.23	1.9		101.00	
	APR	1.6	2.7	0.21	92.2	442,071		4,110	2.57	1,114	1.85	45.5		6.27	2.9		101.00	
	MAY	7.6	4.2	0.28	93.3	561,614		3,414	1.57	1,420	1.99	0.0		0.00	0.0		0.00	
	JUN	13.5	2.7	0.33	87.8	579,910		1,744	0.88	998	1.33	91.0		8.26	7.5		217.10	
	JUL	18.8	2.9	0.38	84.9	679,880		2,600	1.09	2,198	2.44	45.5		8.51	3.9		101.00	
	AUG	20.8	4.2	0.28	93.3	658,948		2,535	1.13	2,025	2.39	0.0		0.00	0.0		0.00	
	SEP	18.0	3.9	0.33	91.5	569,100		1,945	1.00	1,341	1.83	481.8		8.55	41.2		959.50	
	OCT	14.4	4.8	0.21	95.6	501,500		2,869	1.67	1,427	2.20	0.0		0.00	0.0		0.00	
	NOV	8.3	4.8	0.18	96.3	402,760		1,685	1.43	1,383	2.46	391.3		8.08	31.6		787.20	
	DEC	3.9	16.2	0.23	98.6	397,348		1,274	1.88	2,564	3.31	36.4		7.48	2.7		60.60	
1987	JAN	1.8	13.7	0.29	97.9	405,520		1,031	2.42	3,191	3.45	63.7		14.48	9.2		141.40	
	FEB	0.3	6.0	0.22	96.3	403,600	5,984,535	1,597	1.70	1,967	2.79	29.7	1,230.4	8.15	2.4	103.3	60.60	2,524.40
	MAX	22.1	31.9	0.45		788,739		18,279	3.17	3,191	3.45	737.0		26.20	123.5		1,741.00	
	MIN	0.1	2.5	0.18		347,850		0	0.00	0	0.99	0.0		0.00	0.0		0.00	
	AVG	8.7	6.6	0.29	95.6	486,350		4,920	$1.62	855	$2.12	169.3		8.18	17.6		394.57	

ALUM

ACTUAL 1985 COST (MAR. '85 TO FEB. '86) FOR ALUM ONLY SLUDGE HAULAGE (CORRECTED TO THE 1986 PERIOD)	$6,620.39
CALCULATED OPERATING COSTS FOR THE SLUDGE TRANSFER LAGOON (1986 COST OF $4.29/M3)	$12,433.71
COST FOR CHEMICAL TREATMENT USING ALUM ONLY (1986 ACTUAL COST $/ML X RAW WATER TREATED)	$9,689.63
ESTIMATED 1986 OPERATING COSTS	$28,743.73

PAC

ACTUAL 1986 COST (MAR. '86 TO FEB. '87) FOR ALUM & PAC SLUDGE HAULAGE	$2,524.40
CALCULATED OPERATING COSTS FOR THE SLUDGE TRANSFER LAGOON (1986 COST OF $4.29/M3)	$5,278.42
COST FOR CHEMICAL TREATMENT USING PAC ONLY (1986 ACTUAL COST $/ML X RAW WATER TREATED)	$12,717.11
	$20,519.93
SAVINGS $	$8,223.80
SAVINGS %	28.61%

s/6/rhlost

TABLE 4E
ROSEHILL WTP-FORT ERIE ONTARIO
JAR TEST RESULTS

	ALUM					
	1-C	1-2	1-3	1-4	1-5	1-6
COAGULANT DOSAGE (mg/l)	-	5	10	15	20	25
COAGULANT AID (mg/l)	-	-	-	-	-	-
pH	8.2	7.9	7.8	7.8	7.6	7.5
ALKALIN. (mg/l)	101	96	93	88	88	88
TURBIDITY (NTU)	0.42	0.28	0.23	0.21	0.21	0.26
COLOUR (TCU)	2	1	<1	<1	<1	<1
ALUM. RESIDUAL (mg/l) DIGESTED	0.01	0.32	0.3	0.23	0.13	0.13

	PACL					
	2-C	2-2	2-3	2-4	2-5	2-6
COAGULANT DOSAGE (mg/l)	-	5	10	15	25	35
COAGULANT AID (mg/l)	-	-	-	-	-	-
pH	8.1	8.05	8	8.06	7.99	8
ALKALIN. (mg/l)	99	96	99	97	92	94
TURBIDITY (NTU)	4.5	1	1.5	0.6	0.3	0.3
COLOUR (TCU)	6	1.4	<1	<1	<1	1.2
ALUM. RESIDUAL (mg/l) DIGESTED						

	ALUM +PACL					
	3-C	3-2	3-3	3-4	3-5	3-6
COAGULANT DOSAGE (mg/l)	-	10	10	10	10	10
COAGULANT AID (mg/l)	-	1	2	3	4	5
pH	8	7.8	7.8	7.8	7.8	7.7
ALKALIN. (mg/l)	96	90	91	94	93	93
TURBIDITY (NTU)	0.55	0.36	0.25	0.35	0.27	0.31
COLOUR (TCU)	2.5	1.2	<1	1.8	<1	1.2
ALUM. RESIDUAL (mg/l) DIGESTED						

	ALUM+ACTIVATED SILICA					
	4-C	4-2	4-3	4-4	4-5	4-6
COAGULANT DOSAGE (mg/l)	-	10	10	7	7	7
COAGULANT AID (mg/l)	-	0.5	1.5	0.5	1.5	2.5
pH	7.9	8.5	8.9	8.6	8.9	9
ALKALIN. (mg/l)	96	101	128	103	126	147
TURBIDITY (NTU)	0.66	0.45	0.46	0.45	0.38	0.85
COLOUR (TCU)	4	2	2	1.8	1.6	2.2
ALUM. RESIDUAL (mg/l) DIGESTED						

	ALUM + LT22S					
	5-C	5-2	5-3	5-4	5-5	5-6
COAGULANT DOSAGE (mg/l)	-	10	10	7	7	7
COAGULANT AID (mg/l)	-	0.5	1.5	0.5	1.5	2.5
pH	8	7.75	7.8	7.8	7.7	7.8
ALKALIN. (mg/l)	100	99	96	94	94	94
TURBIDITY (NTU)	0.55	0.6	0.4	0.5	0.92	0.2
COLOUR (TCU)	4	2.8	1.6	1.8	2.4	1.2
ALUM. RESIDUAL (mg/l) DIGESTED						

	ALUM ACIDIFIED TO 6.5 pH					
	6-C	6-2	6-3	6-4	6-5	6-6
COAGULANT DOSAGE (mg/l)	-	5	10	15	20	25
COAGULANT AID (mg/l)	-	-	-	-	-	-
pH	8.1	6.7	7	6.2	6.7	7.1
ALKALIN. (mg/l)	93	55	59.5	57	55	60
TURBIDITY (NTU)	0.7	0.32	0.35	0.23	0.12	0.14
COLOUR (TCU)	3	2.2	7.6	6	4.6	6.6
ALUM. RESIDUAL (mg/l) DIGESTED	0.01	0.11	0.22	0.12	0.1	0.12

- The use of alum alone produced treated water which was of adequate quality, (turbidity of 0.23 NTU) and the turbidity varied only by a small amount with the addition of excess alum.

- Using polyaluminum chloride alone was unsuccessful at the chosen dosages with the only low turbidity readings observed at very high dosages of 25 and 35 mg/L.

- Alum (10 mg/L) and polyaluminum chloride (1 - 5 mg/L) jar tests produced the best result of 0.25 NTU at alum (10 mg/L) and polyaluminum chloride (2 mg/L). This was consistent with the current plant operation dosages for August 1987.

- Alum (10 - 7 mg/L) and activated silica (0.5 - 2.5 mg/L) produced unsatisfactory results. The best result of turbidity 0.38 NTU was with alum (7 mg/L) and activated silica (1.5 mg/L).

- Alum and Percol LT22S were unsuccessful in reducing turbidity to low levels.

- Alum addition to water which had already been acidified to pH 6.8 gave very good turbidity removal (0.12 to 0.14 NTU) when the alum dosage was in the 15 to 25 mg/L range.

The aluminum residuals of the effluent from certain jar tests were analyzed. The analyses showed that water which is slightly acidified to a pH of approximately 6.5 exhibited some reduction in the amount of aluminum present as residual.

There was, however, evidence of lower colour removal in the acidified samples.

The results of the jar tests indicate that it is possible to further reduce the level of turbidity in the treated water. Primarily, the pH of the water could be reduced to give optimum conditions for alum flocculation. This should, however, be examined in greater detail.

In order to give fairly constant results for turbidity removal, alum and polyaluminum chloride may provide the optimum chemical combination. Our laboratory study showed that for summer water conditions alum, 10 mg/L, and polyaluminum chloride, 2 mg/L, performed well giving a turbidity of 0.25 NTU. It is possible that this will be further reduced by optimizing the dosages. Plant trials on these optimum dosages will probably give even better particulate removal.

E.2 Optimum Removal Studies

To achieve optimum removal of particulates in a water treatment plant, there are several processes or parameters which must be examined.

These are:

a) Flocculation
b) Clarification
c) Filtration
d) Residual Aluminum

a) Flocculation

It is recognized that flocculation is an effective mechanism to assist in the removal of turbidity in a water treatment plant and that this is the area to which most attention should be given in order to optimize particulate removal.

Flocculation can be improved by the use of the most suitable coagulants or coagulant combination. It has been shown by jar testing carried out in the Proctor and Redfern Laboratory that alum is a suitable coagulant and alum alone was used in the plant prior to December 1985. Alum and polyaluminum chloride have been used and found to give comparable results. From the limited tests available, the best results were obtained by acidifying the raw water prior to treatment with alum. This may not be economically viable for the small decrease in turbidity achieved.

Recycling of plant wastes in order to enhance turbidity removal can be used, particularly on low turbidity raw waters. The Rosehill system recycles the backwash water after two hours settling and it is believed that this may assist the removal process.

b) **Clarification**

Clarification is currently carried out in two settling tanks with a detention time of 45 minutes. It is unlikely that any modifications other than major capital works such as conversion from tube to plate settling, can be made in this area.

c) **Filtration**

The final means of removal of particulates in any plant is by filtration. There are several ways by which filtration may be improved. A finer filter media will reduce the amount of particulates passing through the filter; but, this would mean a lower maximum flow rate and less time between backwashes.

A deeper bed of media would improve filtration; however, this would also lower the maximum flow rate. A multi-media filter may also be used for particulate removal.

In particular, the filter media should be examined periodically in order to determine the state of the media. The media undergoes considerable wear during backwashing and in some cases can even be deposited in the clear well. Such loss or wear of media can have deleterious effects on the final turbidity of the treated water.

d) **Aluminum Residual In Finished Water**

The use of aluminum salt coagulants (alum, polyaluminum chloride, etc.) in potable water treatment plants may lead to increased concentrations of aluminum in the treated water, and this may result in water quality and supply problems. At present, there is no firm evidence that Aluminum is physiologically harmful and no health-related limit has been specified anywhere in the world to our knowledge. However, the concern of potential health problems associated with aluminum frequently emerges.

Water supply problems may be associated with increased aluminum concentrations in treated water. These problems include the formation of a hydrous aluminum precipitate in the distribution system which may increase turbidity and complaints about clarity. Aluminum floc in the system may interfere with the disinfection process by entrapping and protecting microorganisms. Another problem attributed to increased aluminum concentrations is deposition of aluminum hydrolysis products on pipe walls, which decreases carrying capacity. To minimize these problems the Ontario Drinking Water Objectives (ODWO) suggest an operational guideline of <0.1 mg/L as Aluminum in the treated water leaving the plant.

An EPA survey of 186 utilities showed that a number of plants exhibited high residual aluminum when overdosing of alum occurred. Even though some utilities surveyed stated that minimizing the alum dosage is a strategy for controlling residual aluminum, underdosing of alum appears to be just as detrimental to turbidity removal and residual aluminum control as overdosing.

Water quality problems associated with high concentrations of aluminum in finished water have led to discussion of ways to reduce residual aluminum concentrations. One method of reducing aluminum concentration is to optimize coagulation. To have optimum coagulation requires that the best coagulant, dosage and combination of operating conditions be selected for each raw water. The optimum pH range must also be achieved since aluminum is least soluble in water in the pH range 5.5-7.0.

There are treatment plants in Ontario which are currently using residual aluminum as an "operating tool" to optimize the dosage of alum. Operational staff respond to any elevation in residual aluminum and make the necessary adjustment to the plant operation.

A minimum of daily monitoring of aluminum residual and pH leaving the plant is recommended. An acceptable method of aluminum analysis should be used. Frequent examination of this data and Drinking Water Surveillance Program (DWSP) data will supply the needed information on the chemistry and fate of aluminum following water treatment to help operating authorities minimize the concentration of aluminum in the treated water.

E.3 <u>Disinfection</u>

a) <u>General</u>

Disinfection is defined as a treatment that destroys harmful microorganisms including bacteria and virus. Current methods now include chemical and non-chemical means of treatment. Unfortunately chemicals that are capable of destroying bacteria are usually powerful interactive compounds which can combine with organic compounds present in the water. Of the chemicals applied for water disinfection, chlorine is the most widely used. However, research on chlorine has shown that by-products are formed when chlorine is used on water containing elevated dissolved organic carbon and/or high levels of colour. Some of these by products can be hazardous to health in the long term and therefor it is important to minimize the formation of these products. This means that water treatment plants maintain proper disinfection of the water with the minimum formation of chlorinated by-products.

At the Rosehill Treatment plant , chlorination is carried out in the intake well and in the Chlorine contact chamber downstream of the filters.

b) **Disinfection Efficiency**

The ability of any plant to disinfect water depends on two main parameters. These are:

1. The quality of the incoming raw water.
2. The equipment and chemicals present in the plant to provide treatment.

Firstly, the incoming raw water at Fort Erie is of low colour and on average below a turbidity of 20 NTU but above Ministry of the Environment Guidelines. It also contains fairly high coliform levels, the 1986 average faecal coliform level being 19.6/100 ml.
The water leaving the plant has zero faecal coliforms and contains a free chlorine residual of 0.3 mg/L (see Figure 5a and 5b). These results indicate that the plant is operating with sufficient disinfection.

Prechlorination is practised at this plant (see Figure 5c), a technique which undoubtedly aids the formation of chlorinated organics in this water. In addition, when occasional taste and odour problems occur in this source Powdered Activated Carbon (PAC) is added between 2 - 6 seconds ahead of the chlorine dosing points. This short period between PAC addition and chlorine addition will ensure that the PAC is relatively ineffective against the taste and odour due to a combination with the chlorine, thereby necessitating the use of large doses of PAC.

At this point, it should be noted that the Rosehill plant suffers from a disinfection problem which prevents consistent prechlorination of the incoming water. As can be seen in the Block Schematic appended, the water entering the plant is split to go to two different flocculation tanks. The addition point of the chlorine is immediately before this split. However, due to the flow characteristics of the piping under low flow regimes, most of the chlorine travels in a stream leading to the west half of the plant. As a result, the east half receives an inconsistent level of prechlorination.

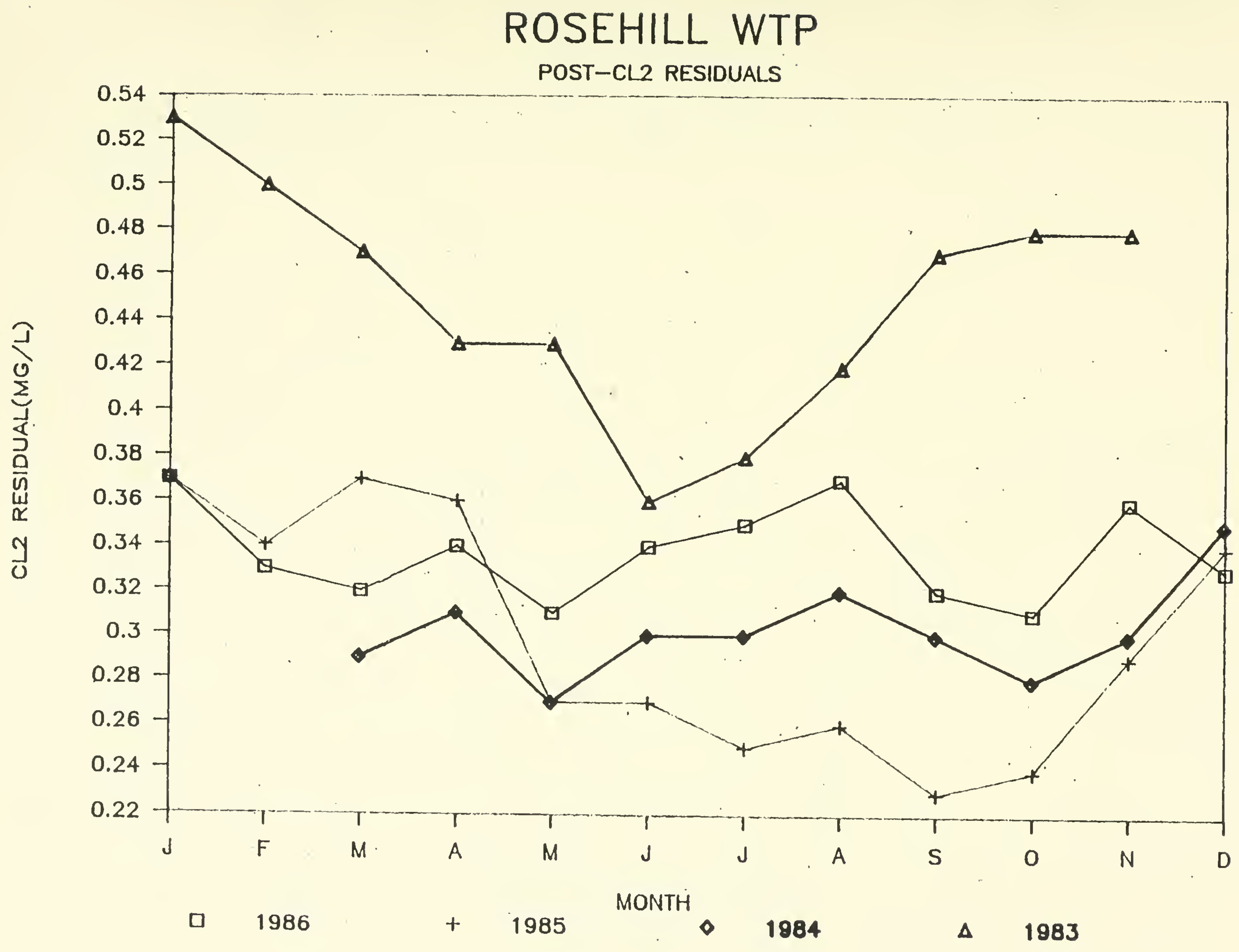
c) **Chlorinated By-Product Formation**

The results from the Drinking Water Surveillance Programme on the Fort Erie water treatment plant show that chlorodibromomethane, chloroform, bromoform, dichlorobromomethane are being formed only in small quantities within the plant process. The amount of these chemicals present is very low and present no problem at the present time. The concentrations of trihalomethanes present compared to the current guideline are given in Table 5.1

Table 5.1

Compound	Raw Water	Treated Water	Drinking Water Objective
Bromoform	N.D.	0.3 ug/L	350 ug/L*
Chlorodibromomethane	N.D.	2.3 ug/L	350 ug/L
Chloroform	Trace	12 ug/L	350 ug/L
Dichlorobromomethane	N.D.	4.6 ug/L	350 ug/L

* Total THM



ROSEHILL WTP
POST-CL2 RESIDUALS
CL2 RESIDUAL(MG/L)
0.54
0.52
0.5
0.48
0.46
0.44
0.42
0.4
0.38
0.36
0.34
0.32
0.3
0.28
0.26
0.24
0.22
J F M A M J J A S O N D
MONTH
1986
1985
1984
1983

FIG. 5a

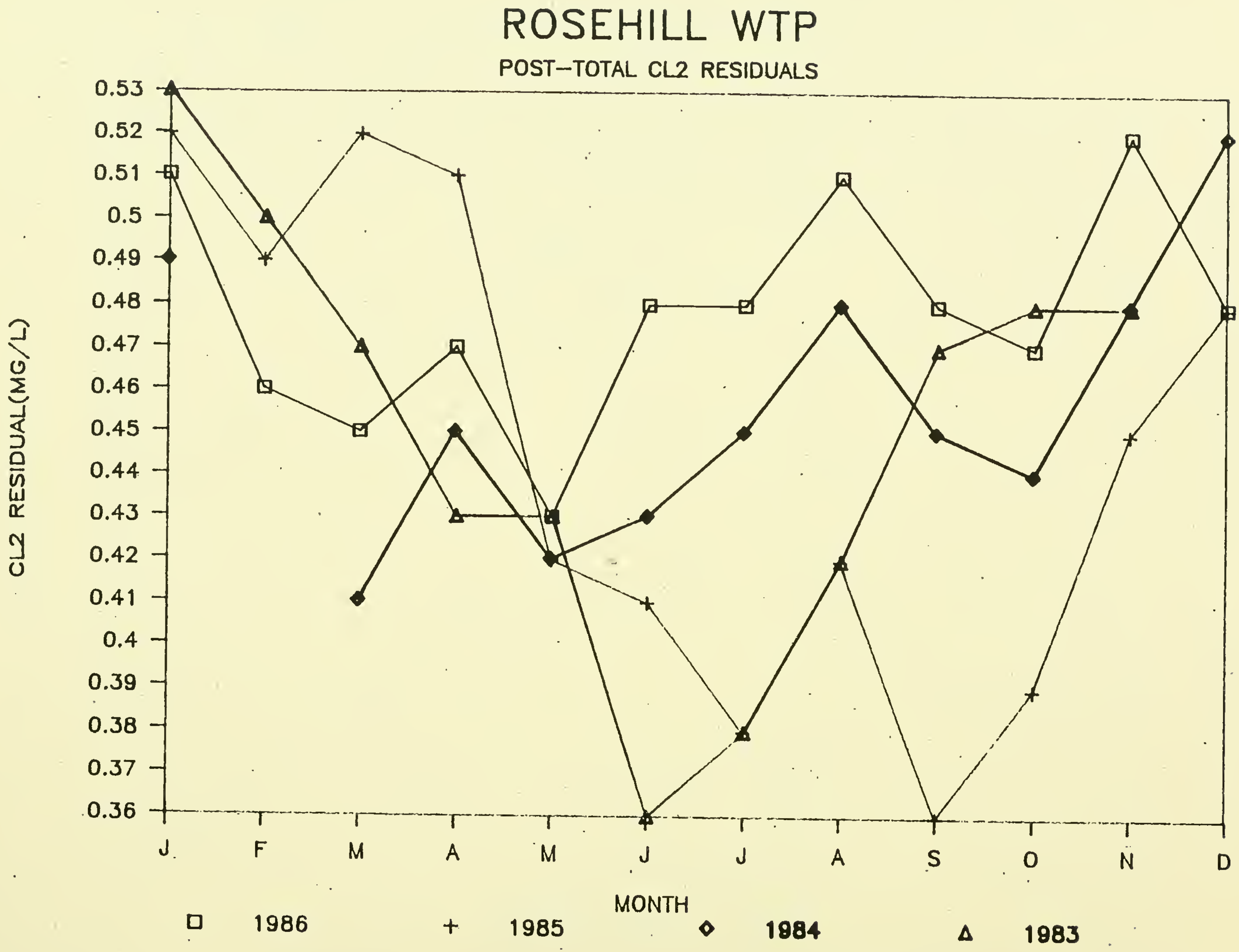

ROSEHILL WTP
POST-TOTAL CL2 RESIDUALS
CL2 RESIDUAL(MG/L)
0.53
0.52
0.51
0.5
0.49
0.48
0.47
0.46
0.45
0.44
0.43
0.42
0.41
0.4
0.39
0.38
0.37
0.36
J F M A M J J A S O N D
MONTH
1986
1985
1984
1983

FIG. 5b

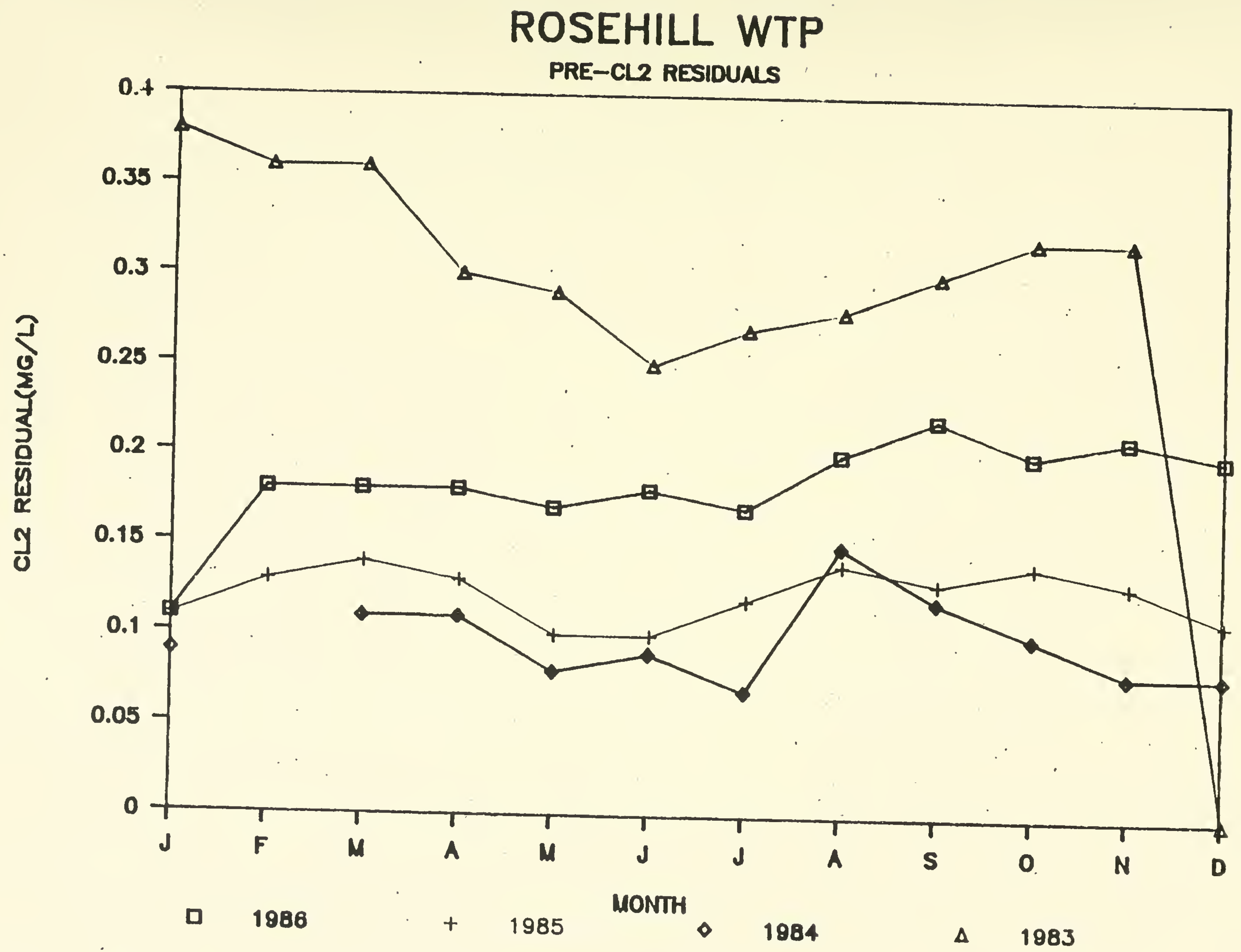

ROSEHILL WTP
PRE-CL2 RESIDUALS
CL2 RESIDUAL(MG/L)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
J F M A M J J A S O N D
MONTH
□ 1986
+ 1985
◇ 1984
Δ 1983

FIG. 5c

SECTION F SHORT TERM MODIFICATIONS

SECTION F. SHORT TERM MODIFICATIONS

F.1 Particulates

Turbidity can best be reduced by coagulation and filtration of the raw water. The chemical most commonly used for this process is aluminum sulphate. This chemical, although very effective, works best within a fairly narrow pH range and when the water temperature is above 7^{O}C. In this study it was determined that alum used in conjunction with polyaluminum chloride gives superior water quality over a wide range of conditions. The use of polyaluminum chloride and alum has proven to be:

- more economical due to less sludge production
- as good as alum alone and, occasionally, better for turbidity removal
- able to reduce the soluble aluminum
- apparently more effective under lower temperature conditions

The dosage of polyaluminum chloride to the raw water stream should be investigated, but generally the practice is to add the alum upstream of the polyaluminum chloride. The control of the polyaluminum chloride pump should be flow paced with the pump stroke length varied on filter effluent quality and baseline data obtained from jar testing and analytical analysis (i.e. turbidity and alum residuals). A more immediate response to dosage control of the coagulants is either by settled water turbidity (obtained from the settled water channel prior to entering the filters) or through a streaming current monitor. There should be a dedicated pump for each half of the plant with variable speed, controlled from the raw water flow. Manual stroke length or automatic stroke length adjustment could be incorporated. The latter would be recommended if streaming current monitors are used.

The system could be installed in the area of the sodium hydroxide feed area which is currently not used. The existing 22,750 litre fiberglass storage vessel could be used with the addition of a smaller day tank (i.e. 500 litres) and three chemical metering pumps, one for each half of the plant and one for standby. Variable speed features would be incorporated as well as automatic stroke length adjustment.

It is recommended that at the very least the filter effluent turbidimeter be replaced with a different make, and that preferably a turbidimeter be installed on the discharge of each of the four filters.

It is recommended that a streaming current monitor be installed in order to determine conclusively if the process variable requires continuous monitoring and control.

While media depth is regularly checked, a check of media gradation should also be undertaken every year.

The acidification of raw water ahead of coagulation was studied during the jar tests and the results were encouraging from the turbidity and residual aluminum point of view. Considerable additional pilot studies would be required, and there is currently no evidence that sufficient benefit would be achieved.

F.2 Disinfection

A method is required to balance the chlorination dosage to the two halves of the plant. It is suggested that the simplest methods be implemented initially, such as opening the connection between the two 400 mm lines upstream of the flocculators, or relocating the chlorine dosage point.

Another alternative currently under consideration is the relocation of pre-chlorination to the Low Lift Pumping Station, although this would also require relocation of the PAC dosage point.

F.3 General

A method of monitoring sludge depth in the settling tanks is required. Continuous automatic monitoring is not readily available. A manual method using an optical sludge blanket detector is recommended.

Reduction of wear on the pistons in the filter rate of flow control valves is required. It is understood that the valve manufacturer and the Region are currently trying alternative materials and valve orientations in order to reduce this wear.

It would also be desirable to rewire the two rate of flow controllers not currently available for use on standby power.

SECTION G LONG TERM MODIFICATIONS

SECTION G. LONG TERM MODIFICATION

G.1 Particulates

As stated earlier in Section C.3 k, the Rosehill plant returns settled backwash water to the head of the plant. This system should be further researched in order to determine if it acts as an aid to the coagulation/flocculation/sedimentation processes.

If the tube settlers continue to deteriorate over time, they could be replaced with new tube settlers or with a tilting plate system. Implementation of this system will require a review of the existing settling tank hydraulics and solids removal system as well as the introduction of recycled backwash and sludge.

It may also be desirable to investigate a method for improving sludge scour in the backwash holding tank. The cost of any such modification must, however, be balanced against the current costs associated with manual cleaning.

APPENDIX A - TABLES

TABLE 1
WATER PLANT OPIMIZATION STUDY
"PLANT FLOWS"

TABLE 1.0: FLOWS (ML/d)

		1986			1985			1984		
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG
JAN	R	18.02	11.50	14.45	14.34	10.32	12.17	16.09	11.25	13.69
	T	16.85	12.29	13.76	13.33	10.16	11.77	14.25	11.44	12.72
FEB	R	19.52	12.18	14.87	14.88	11.13	12.42	-	-	12.86
	T	14.30	12.19	13.37	13.39	11.00	12.22	13.51	11.04	12.34
MAR	R	16.92	12.16	14.01	14.91	10.70	12.87	14.06	11.86	12.95
	T	15.65	12.59	13.97	12.44	10.64	11.74	12.90	10.58	12.11
APR	R	17.07	10.42	14.74	15.35	8.70	12.42	14.45	11.52	13.01
	T	15.97	11.65	13.61	14.64	10.56	12.32	14.27	10.61	12.34
MAY	R	25.16	12.23	18.12	20.56	9.83	15.82	15.75	11.74	13.44
	T	24.76	12.59	17.34	19.59	11.83	15.07	14.82	11.60	12.92
JUN	R	23.79	13.68	17.66	22.22	9.11	18.14	26.27	11.96	19.20
	T	21.67	15.26	17.39	23.33	13.63	17.25	24.62	13.42	17.57
JUL	R	34.75	15.90	21.93	38.61	13.23	23.74	37.82	14.84	23.90
	T	32.72	15.17	20.13	36.36	14.77	22.58	36.44	14.85	22.88
AUG	R	26.43	17.71	21.26	35.02	11.94	25.44	38.68	15.48	22.11
	T	24.72	15.74	19.47	34.64	15.82	24.19	35.51	15.48	22.06
SEP	R	26.15	13.74	18.97	16.02	10.88	16.08	18.07	13.18	15.38
	T	25.01	15.16	16.77	18.22	14.29	15.88	16.66	12.24	13.81
OCT	R	20.10	13.97	16.18	14.58	9.43	14.08	18.27	12.10	13.90
	T	18.42	12.24	14.69	14.73	12.79	13.39	13.28	10.24	11.87
NOV	R	14.56	10.59	13.43	14.83	8.80	12.02	15.91	10.14	12.71
	T	12.65	10.30	11.66	13.40	11.10	12.39	12.75	10.46	11.54
DEC	R	15.45	9.10	12.82	15.84	10.03	13.17	12.45	8.30	10.97
	T	12.88	9.86	11.96	14.97	11.81	12.62	11.70	9.79	10.77

TABLE 1.1: PER CAPITA CONSUMPTION
(L/D/CAPITA)

CONSUMPTION	1986	1985	1984
POPULATION*	24,000	24,000	24,000
MAXIMUM DAY	818	795	767
MINIMUM DAY	538	515	492
AVE DAY	639	630	600
RATIO MD:AD	1.28	1.26	1.28

* FROM STATISTICS CANADA 1987 MUNICIPAL DIRECTORY

TABLE 2
WATER PLANT OPTIMIZATION STUDY
"PARTICULATE REMOVAL SUMMARY"

TABLE 2.0: PARTICULATE REMOVAL SUMMARY ROSEHILL ROAD WTP

MOE WPOS PROTOCOL

			1986			1985			1984		
			MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
JAN	Turbidity (NTU)	R	24.00	4.2	10.1	42	6	16.6	16	2.5	5.37
		T	1.70	0.05	0.45	0.51	0.1	0.26	0.87	0.14	0.29
	Colour (TCU)										
	Prime Coagulant (mg/L)		34.63	1.89	13.84	36.55	14.34	21.63	18.7	4.29	8.32
	Coagulant Aid (mg/L)										
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R									
		T									
	Temperature (C)		1.00	1	1	3.5	0	1.54	1	0	0.47
FEB	Turbidity (NTU)	R	6.00	2.2	3.41	8.1	3.1	4.96	9.3	2.5	4.14
		T	1.50	0.11	0.44	0.64	0.11	0.3	1.8	0.17	0.53
	Colour (TCU)										
	Prime Coagulant (mg/L)					18.55	11.68	14.4	6.91	2.57	4.42
	Coagulant Aid (mg/L)		5.28	0.57	1.71						
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R									
		T									
	Temperature (C)		1.00	1	1	0	0	0	1	0	0.47
MAR	Turbidity (NTU)	R	13.00	3.9	3.2	5.6	2.0	4.35	8.2	3.0	3.78
		T	1.40	0.15	0.43	0.9	0.1	0.47	1.5	0.2	0.42
	Colour (TCU)										
	Prime Coagulant (mg/L)		15.01	4.04	9.38	15.97	4.11	9.08	8.1	3.5	4.75
	Coagulant Aid (mg/L)		2.95	0.95	1.52						
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R									
		T									
	Temperature (C)		1.00	1	1	0	0	0	0.9	0.5	0.7
APR	Turbidity (NTU)	R	34.00	1.2	2.74	8.0	2.2	4.73	18.8	2.4	4.88
		T	0.57	0.11	0.21	0.9	0.12	0.34	0.89	0.15	0.32
	Colour (TCU)										
	Prime Coagulant (mg/L)		14.48	4.69	12.44	10.08	3.93	6.17	8.84	4.07	6.63
	Coagulant Aid (mg/L)		3.00	1.14	2.19						
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R									
		T									
	Temperature (C)		5.70	1.2	1.6	2.01	0	0.36	6.2	0	2.66

BLE 2.0: (CONT'D)

			1986			1985			1984		
			MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
Y	Turbidity (NTU)	R	43.00	0.68	4.2				45	3	7.58
		T	0.60	0.1	0.28				0.62	0.13	0.26
	Colour (TCU)										
	Prime Coagulant (mg/L)		20.49	2.76	8.22				12.24	6.56	9.51
	Coagulant Aid (mg/L)		3.50	0.55	1.71						
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R									
		T									
	Temperature (C)		10.10	5.3	7.6				11	5.2	8.2
N	Turbidity (NTU)	R	12.00	0.83	2.67	34	2.8	4.41	33	1.4	4.3
		T	0.82	0.17	0.33	0.79	0.14	0.23	0.36	0.06	0.2
	Colour (TCU)										
	Prime Coagulant (mg/L)		6.74	2	4.18	10	4.5	8.28	12.72	6.14	9.2
	Coagulant Aid (mg/L)		2.18	1.11	1.54						
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R									
		T									
	Temperature (C)		17.00	10	13.5	17.2	13	14.8	20	11	13.1
	Turbidity (NTU)	R	13.00	1.3	2.92	12	1.1	3.35	19	1	2.81
		T	0.74	0.17	0.38	0.29	0.12	0.19	0.5	0.13	0.25
	Colour (TCU)										
	Prime Coagulant (mg/L)		8.00	2.43	10.74	8.92	6.44	7.64	10.96	4.95	7.08
	Coagulant Aid (mg/L)		2.20	0.69	1.36						
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R									
		T									
	Temperature (C)		22.00	17	19	22	17	19.3	22	19	20.5
A	Turbidity (NTU)	R	17.00	1.3	4.22	25	1	2.5			
		T	0.42	0.16	0.28	0.37	0.11	0.21			
	Colour (TCU)										
	Prime Coagulant (mg/L)		5.94	3.38	4.92	16.35	5.93	7.98			
	Coagulant Aid (mg/L)		3.09	1.51	2.45						
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R									
		T									
	Temperature (C)		22.00	19	21.5	22.5	22	22.11			

TABLE 2.0: (CONT'D)

			1986			1985			1984		
			MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
SEP	Turbidity (NTU)	R	32.00	1.1	3.86	11	1	2.5	16	0.9	3.1
		T	0.73	0.17	0.33	0.56	0.2	0.33	0.56	0.2	0.35
	Colour (TCU)										
	Prime Coagulant (mg/L)		10.65	1.37	4.22	9.86	3.35	6.06	6.94	3.31	4.91
	Coagulant Aid (mg/L)		3.18	0.98	2.12						
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R									
		T									
	Temperature (C)		20.00	8	18	21.9	18.5	20.4	23	18	19.8
OCT	Turbidity (NTU)	R	29.00	1	4.83	14	1.3	4.08	10	1	2.89
		T	0.30	0.14	0.21			0.27	0.53	0.21	0.32
	Colour (TCU)										
	Prime Coagulant (mg/L)		16.49	5.17	7.39	9.84	4.7	6.73	5.25	3.38	4.33
	Coagulant Aid (mg/L)		3.69	1.46	2.69						
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R									
		T									
	Temperature (C)		17.90	12.1	14.4	18	12.2	15	18	14.9	15.3
NOV	Turbidity (NTU)	R	12.00	1.4	4.79	25	1.1	5.38	32	2	8.2
		T	0.30	0.1	0.18	3.8	0.07	0.36	1.4	0.16	0.39
	Colour (TCU)										
	Prime Coagulant (mg/L)		14.82		6.31	20.57	3.45	18	9.12	3.25	5.97
	Coagulant Aid (mg/L)		3.94	2.15	1.68						
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R									
		T									
	Temperature (C)		12.40	5	8.3	13	7	9.35	14	5.5	9.3
DEC	Turbidity (NTU)	R	34.00	1.9	16.18	73	2.2	31.86	27	4	12.44
		T	0.44	0.13	0.23	1.75	0.07	0.28	0.77	0.09	0.34
	Colour (TCU)										
	Prime Coagulant (mg/L)		14.86	3.35	8.37	41.1	16.67	29.5	26.22	5.73	15.24
	Coagulant Aid (mg/L)		4.53	2.09	3.39						
	Metal Res. Al/Fe (mg/L)	R									
		T									
	pH	R									
		T									
	Temperature (C)		5.00	2	4.6	7	1	3.6	6.8	1.2	4.2

TABLE 2.1 : PARTICULATE REMOVAL PROFILE. (JANUARY/1986)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
1	20.8	2.83	2.82	0.14	23.27	-	1
2	18.7	3.87	4.77	0.11	21.71	-	1
3	18.5	5.7	2.88	0.17	19.65	-	1
4	14.8	12.33	3.98	1.12	21.49	-	1
5	15.3	2.55	3.03	1.26	24.07	-	1
6	13.8	2.43	4.07	0.48	29.15	-	1
7	12.3	1.4	1.47	0.39	34.63	-	1
8	11	1.68	1.53	0.31	28.81	-	1
9	13.5	2.63	4.15	0.29	21.76	-	1
10	10.7	2.25	2.52	0.17	25.07	-	1
11	11.6	2.32	3.78	0.11	28.27	-	1
12	13	2.33	2.55	0.11	21.05	-	1
13	11	3.73	3.55	0.08	16.86	-	1
14	9.4	8.32	3.98	0.43	12.91	-	1
15	8.6	5.96	7.93	0.63	7.71	-	1

TABLE 2.1 : PARTICULATE PROFILE. (JANUARY/1986)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AIO	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
16	9.2	7.78	8.72	0.58	4.17	-	1
17	8	6.15	6.52	0.4	4.88	-	1
18	7	4.62	5.02	0.31	5.53	-	1
19	6	5.32	5.83	0.24	4.65	-	1
20	10	7.26	6.45	0.35	4.86	-	1
21	6.5	5.33	5.7	0.31	6.36	-	1
22	6.6	5.28	5.72	0.2	5.47	-	1
23	6.5	5.2	5.45	0.32	6.64	-	1
24	5.7	4.96	5.45	0.44	4.96	-	1
25	6.3	5.8	5.73	1.29	8.24	-	1
26	6.5	5.9	O/S	1.5	2.47	-	1
27	7.5	6.98	O/S	0.44	2.79	-	1
28	6	5.83	O/S	0.36	1.89	-	1
29	5.8	4.56	O/S	0.61	4.56	-	1
30	5.6	3.46	O/S	0.33	4.75	-	1
31	7.5	5.55	O/S	0.4	3.63	-	1

TABLE 2.1 : PARTICULATE REMOVAL PROFILE. (APRIL/1986)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
1	2.2	1.18	1.85	0.33	8.4	1.14	1
2	1.9	1.3	1.7	0.28	13.24	2.13	1
3	2.2	1.22	1.77	0.18	12.83	2.14	1
4	2.3	1.38	1.75	0.19	13.61	2.17	1
5	2.02	1.25	1.62	0.24	12.56	2.05	1
6	2.22	1.12	1.83	0.22	13.27	2.16	1
7	2.42	1.22	1.38	0.19	11.71	2.12	1
8	1.42	1.07	1.43	0.26	12.47	2.14	1
9	1.35	1.04	1.68	0.19	12.37	2.14	1
10	1.82	1.23	1.62	0.16	12.5	2.11	1
11	2.55	1.25	1.55	0.22	13.67	2.64	1
12	1.8	1.25	2	0.21	13.52	2.11	1
13	1.8	1.13	1.67	0.22	12.89	2.04	1
14	1.5	1.08	1.63	0.25	11.96	2.71	1
15	1.4	0.98	1.27	0.21	13.7	2.06	1

TABLE 2.1 : PARTICULATE REMOVAL PROFILE. (APRIL/1986)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
16	1.4	1.02	1.3	0.16	13.5	2.19	1
17	1.5	1.11	1.45	0.1	12.35	2.05	1
18	2.1	1.28	1.93	0.15	12.81	2.21	1
19	2.35	1.35	2.1	0.18	12.22	2.13	1
20	2.14	1.38	1.9	0.17	13.68	2.18	2
21	2.13	1.4	1.85	0.17	12.57	2.09	1.2
22	2.45	1.73	2.03	0.2	4.69	1.31	1.2
23	2.7	1.65	2.33	0.26	10.56	2.04	1.2
24	3.42	1.78	2.37	0.2	14	1.63	1.2
25	13.5	2.87	5.55	0.35	13.05	2.82	2.9
26	4.58	1.63	2.65	0.29	13.35	3	3
27	2.5	1.27	2.03	0.14	12.43	2.43	3.2
28	2.6	1.27	1.9	0.19	12.05	2.28	3.8
29	4.52	1.47	2.48	0.16	12.76	2.62	5.5
30	5.45	1.7	2.58	0.14	14.48	2.98	5
31	-	-	-	-	-	-	-

TABLE 2.1 : PARTICULATE REMOVAL PROFILE. (JULY/1986)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
1	2.52	1.6	1.8	0.25	1.96	0.69	17
2	2.53	2.35	2.07	0.34	1.75	0.75	17
3	2.45	2.47	2.07	0.33	1.77	0.7	17
4	3.1	2.38	3.23	0.38	8.09	1.35	17.5
5	7.8	3.9	4.83	0.45	5.52	1.48	17.5
6	4.8	1.88	2.75	0.4	6.84	1.47	17.5
7	3.52	1.75	2.68	0.29	5.78	1.47	17.5
8	2.7	1.73	3.12	0.38	3.4	1.27	17.5
9	1.47	1.35	1.53	0.47	3.91	1.32	17.5
10	2.06	1.77	2	0.48	4.02	1.24	17.5
11	1.8	1.72	1.88	0.59	3.97	1.19	17.5
12	1.6	1.25	1.68	0.41	4.33	1.4	17.5
13	1.67	1.2	1.92	0.44	3.59	1.18	18.7
14	7.48	2.58	4.8	0.58	5.42	1.71	19
15	4.1	2.6	3.33	0.47	4.12	1.62	19

TABLE 2.1 : PARTICULATE REMOVAL PROFILE. (JULY/1986)

OATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
16	2.8	2.23	2.78	0.67	3.7	1.75	19.5
17	2.9	1.62	2.22	0.51	4.24	1.76	19
18	1.86	1.55	1.58	0.33	3.93	1.62	19
19	2.38	1.42	2.17	0.37	6.28	1.61	19
20	2.16	1.47	1.97	0.3	5.36	1.57	19
21	2.12	1.38	2.17	0.31	5.86	1.73	19
22	2.48	1.35	1.77	0.3	4.88	1.8	19.8
23	2.53	1.38	1.87	0.37	5.72	1.52	19.8
24	2.91	1.57	2.17	0.34	5.46	2.2	20
25	2.33	1.6	2	0.35	2.54	0.98	20
26	3.03	1.8	2.27	0.26	2.63	1.09	21
27	3.73	1.63	1.98	0.23	2.49	1.18	21
28	2.98	1.82	2.28	0.28	2.67	1.1	21
29	2.08	1.58	1.88	0.31	2.45	1.1	22
30	2.77	1.37	1.82	0.28	2.62	1.21	22
31	1.92	1.2	1.37	0.2	2.43	1.25	22

TABLE 2.1 : PARTICULATE REMOVAL PROFILE. (OCTOBER/1986)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
1	9.9	1.77	1.67	0.24	7.31	2.07	17.8
2	2	1.47	1.37	0.11	5.27	1.91	17.8
3	2.85	1.95	1.38	0.22	6.1	1.68	17.4
4	4.08	2.35	2.03	0.28	7.18	1.59	17.4
5	3.4	2.28	2.03	0.27	6.48	2.08	17
6	13.9	3.58	4.48	0.42	6.76	2.81	16.1
7	9.6	2.32	3.48	0.29	6.55	2.9	15
8	8.7	1.82	1.92	0.21	6.5	2.9	15
9	6.8	2.23	2.03	0.16	6	3.69	14.7
10	1.9	1.32	1.38	0.19	6.56	3.34	14
11	2.7	1.35	2.02	0.17	6.96	3.15	13.5
12	2.48	1.48	1.3	0.13	6.11	3.23	13.3
13	2.98	1.48	1.52	0.16	6.16	3.28	13.6
14	7.52	2.18	2.03	0.2	14.09	3.62	14
15	13.9	3.42	2	0.24	14.43	3.21	14

TABLE 2.1 : PARTICULATE REMOVAL PROFILE. (OCTOBER/1986)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
16	12.6	2.88	2.5	0.23	16.49	3.65	13.2
17	5.02	2.37	2.65	0.21	7.94	3.42	17.9
18	4.03	2.02	2.57	0.2	8.98	3.03	17.6
19	3.12	1.5	1.92	0.15	7.08	2.34	12.6
20	2.95	1.52	2.43	0.17	7.48	2.46	12.6
21	3.55	1.72	2.47	0.19	7.2	2.41	12.6
22	2.7	1.56	2.25	0.21	7.1	2.45	12.6
23	3.3	1.58	2.4	0.23	6.98	2.41	13.2
24	3.5	1.15	1.65	0.21	5.81	2.17	13
25	1.73	1.06	1.43	0.2	6.8	2.39	13
26	1.66	0.97	1.53	0.2	4.4	1.46	13
27	1.53	1.17	1.6	0.24	6.06	2.45	13.1
28	2.45	1.4	1.67	0.25	6.05	2.55	13
29	3.88	1.48	1.77	0.22	6.51	2.85	13
30	2.83	1.18	1.42	0.2	6.58	2.86	13
31	1.6	1.28	1.57	0.18	5.17	2.68	12.1

TABLE 2.2 : PARTICULATE REMOVAL PROFILE (JANUARY/1985)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
1	16.9	2.53	2.95	0.21	16.79	-	3.5
2	17.5	2.1	2.96	0.2	16.57	-	3.5
3	12.7	O/S	3.18	0.18	17.55	-	3.4
4	8.6	O/S	2.95	0.21	18.41	-	3.2
5	9.7	1.95	2.71	0.21	17.71	-	3.2
6	11.6	1.67	3.58	0.2	14.34	-	3.1
7	14.4	2.18	2.8	0.16	16.76	-	3.1
8	15.9	2.95	3.46	0.21	18.48	-	3.1
9	11.9	2.15	2.45	0.19	21.21	-	3
10	9.5	O/S	3.42	0.24	18.22	-	3
11	7.86	1.95	2.78	0.21	15.99	-	3
12	16.8	O/S	3.4	0.16	15.59	-	2.9
13	21.3	O/S	3.5	0.21	19.82	-	2.8
14	24.3	O/S	4.07	0.23	20.73	-	2.7
15	30.4	3.42	5.32	0.28	26.84	-	2.8

TABLE 2.2 : PARTICULATE REMOVAL PROFILE (JANUARY/1985)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
16	26.6	O/S	6.97	0.26	25.92	-	0.2
17	26.6	O/S	10.24	0.28	27.97	-	0
18	29.8	O/S	7.05	0.23	29.82	-	0
19	31.5	O/S	3.98	0.41	31.4	-	0
20	32.5	O/S	4.23	0.21	28.3	-	0
21	28.6	O/S	3.85	0.32	35.2	-	0
22	15.8	O/S	4.86	0.29	32.4	-	0
23	15	O/S	6.25	0.22	36,55	-	0
24	12	O/S	5.53	0.32	35.3	-	0
25	11.1	O/S	9.8	0.34	14.96	-	0.2
26	10.9	O/S	6.57	0.43	16.01	-	0.2
27	10.3	O/S	9.38	0.33	17.16	-	0.2
28	9.7	O/S	6	0.3	16.37	-	0.2
29	8.7	O/S	5.03	0.31	15.25	-	0.2
30	8.3	O/S	4.95	0.28	14.18	-	0.2
31	7.38	O/S	4.4	0.26	18.9	-	0

TABLE 2.2 : PARTICULATE REMOVAL PROFILE (APRIL/1985)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
1	2.65	2.58	O/S	0.28	4.88	-	0
2	4.2	5.33	O/S	0.19	5.79	-	0
3	2.9	2.68	O/S	0.25	6.37	-	0
4	2.8	3.65	O/S	0.17	6.14	-	0
5	3.96	3.9	O/S	0.2	4.86	-	0
6	6.08	5.41	O/S	0.19	6.91	-	0
7	6.46	9.98	O/S	0.17	6.32	-	0
8	6.13	5.33	O/S	0.22	6.12	-	0
9	6.06	5.81	O/S	0.22	6.91	-	0
10	6.76	5.81	O/S	0.24	6.91	-	0
11	6.53	5.66	O/S	0.17	7.68	-	0
12	5.58	5.26	O/S	0.24	6.34	-	0
13	4.45	4.38	O/S	0.23	6.11	-	0
14	4.2	3.78	O/S	0.21	5.34	-	0
15	3.73	3.7	O/S	0.23	3.93	-	0

TABLE 2.2 : PARTICULATE REMOVAL PROFILE (APRIL/1985)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
16	4.1	3.51	4.12	0.28	4.33	-	0.5
17	3.93	3.28	3.3	0.56	4.42	-	0.5
18	4.06	3.18	3.2	0.62	4.29	-	0.5
19	3.22	2.96	3.3	0.62	5.13	-	0.5
20	3.68	3.93	4.41	0.64	4.53	-	0.2
21	4.17	3.1	3.28	0.41	4.37	-	0.4
22	4.8	3.81	5.05	0.58	4.09	-	0.2
23	4.98	4	4.13	0.61	4.29	-	0.5
24	4.33	3.68	4.1	0.61	4.42	-	0.9
25	7	4.88	4.75	0.52	6.53	-	0.9
26	6.02	4.53	4.36	0.43	8.94	-	0.9
27	4.43	2.4	3.11	0.31	9.56	-	0.9
28	4.47	2.23	2.98	0.23	9.53	-	1
29	5.78	3.13	3.38	0.29	10.08	-	1
30	4.43	1.96	2.2	0.27	9.9	-	2.01
31	-	-	-	-	-	-	-

TABLE 2.2 : PARTICULATE REMOVAL PROFILE (JULY/1985)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
1	2.15	1.18	1.15	0.17	6.52	-	17.8
2	1.95	1.01	1.2	0.19	6.74	-	17
3	3.33	1.43	1.58	0.17	6.69	-	17
4	5.2	1.78	1.98	0.18	8.24	-	17
5	2.9	1.41	1.6	0.17	7.22	-	17
6	3.2	1.36	1.4	0.19	6.44	-	17
7	4.7	1.36	1.32	0.2	7.79	-	18
8	8	1.42	1.48	0.2	8.92	-	18
9	4.5	O/S	1.98	0.17	7.18	-	18
10	5.1	O/S	2.31	0.16	9.9	-	18
11	3.2	O/S	1.93	0.16	8.64	-	20
12	3.35	O/S	2.38	0.14	8.33	-	20
13	3	1.7	1.68	0.18	8.28	-	20
14	3.15	1.76	1.85	0.2	7.12	-	20
15	4.15	2.1	2.46	0.23	6.46	-	20

TABLE 2.2 : PARTICULATE REMOVAL PROFILE (JULY/1985)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
16	4.28	1.88	2.08	0.22	8.07	-	20
17	4.6	1.9	1.88	0.2	6.91	-	20
18	2.36	1.66	1.51	0.19	7.07	-	20
19	1.94	1.28	1.36	0.2	7.7	-	20
20	1.95	1.25	1.35	0.18	7.52	-	20
21	1.88	1.15	1.1	0.22	8.44	-	20
22	2.65	1	1.03	0.17	7.67	-	20
23	2.78	1.31	1.26	0.17	8.15	-	20
24	1.63	1.31	1.2	0.19	8.31	-	20
25	4.72	2.06	1.71	0.2	7.31	-	20
26	2.9	1.62	1.58	0.19	8.53	-	20
27	2.4	1.5	1.47	0.16	6.95	-	20
28	2.7	1.48	1.53	0.17	6.76	-	20
29	3.7	2.06	2.02	0.21	7.85	-	20

TABLE 2.2 : PARTICULATE REMOVAL PROFILE. (OCTOBER/1985)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
1	5.05	1.42	1.92	0.24	6.35	-	18
2	4	1.75	1.68	0.23	7.93	-	17.8
3	2.4	1.22	1.78	0.2	6.68	-	17.5
4	1.48	1.05	1.16	0.32	4.52	-	18
5	7.78	1.33	1.5	0.32	6.31	-	17.4
6	9.97	2.43	2.27	0.26	8.07	-	15.9
7	9.42	2.03	2.5	0.22	6.97	-	15.9
8	7.8	2.97	3.87	0.23	6.22	-	15
9	6.6	2.33	2.87	0.33	6.65	-	15.5
10	8.3	3.45	2.72	0.38	7.83	-	15.5
11	5.8	1.36	1.36	0.27	8.16	-	15.1
12	3	1.12	1.02	0.2	9.37	-	15
13	4.5	2.7	1.55	0.2	9.84	-	15
14	2.8	1.43	1.42	0.31	7.96	-	15.5
15	2.1	1.23	1.1	0.21	8.43	-	15.5

TABLE 2.2 : PARTICULATE REMOVAL PROFILE. (OCTOBER/1985)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
16	3.7	1	1.23	0.24	8.71	-	15
17	3.7	1.32	1.88	0.2	7.67	-	14
18	3	1.07	1.13	0.23	7.21	-	14.2
19	2.35	1.13	1.2	0.18	6.66	-	15
20	2.48	1.1	1.17	0.16	6.49	-	15
21	1.9	0.98	1.38	0.22	6.13	-	14.2
22	1.78	0.91	1.68	0.33	6	-	14
23	1.45	1.02	1.17	0.28	4.7	-	14
24	3.14	1.72	2.5	0.31	5.3	-	14
25	3.6	1.6	1.83	0.42	6.43	-	14.8
26	3.4	1.5	1.73	0.32	5.98	-	14.8
27	4.6	1.9	1.68	0.31	5	-	14
28	4	1.77	1.83	0.35	5.88	-	13.8
29	2.2	1.57	1.58	0.38	5.84	-	13
30	2.3	1.47	2	0.38	4.7	-	12.2
31	1.9	1.38	1.62	0.38	4.53	-	12.3

TABLE 2.3 : PARTICULATE REMOVAL PROFILE. (JANUARY/1984)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
1	11.2	5.5	4.56	0.21	9.5	-	1
2	8.5	4.66	5.9	0.18	9.5	-	0
3	9	5.46	5.35	0.23	9.44	-	0
4	9	5.25	4.98	0.32	9.07	-	0.5
5	7.8	6.82	6.28	0.33	7.89	-	0.5
6	6.3	3.9	3.54	0.41	18.7	-	1
7	4.3	3.86	3.4	0.42	12.06	-	1
8	5.1	3.83	3.2	0.39	10.67	-	1
9	5.4	3.95	2.8	0.34	12.64	-	1
10	5.3	3.87	3.27	0.29	9.45	-	0.5
11	6.1	4.32	3.7	0.26	11.5	-	0.5
12	9.9	3.88	3.48	0.25	9.53	-	0.5
13	6.16	3.85	3.28	0.26	9.91	-	0.3
14	4.88	2.62	2.93	0.19	10.87	-	0
15	4.64	3.18	3.3	0.18	8.86	-	0

TABLE 2.3 : PARTICULATE REMOVAL PROFILE. (JANUARY/1984)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
16	4.55	3.85	3.8	0.21	5.3	-	0
17	4.91	3.67	3.83	0.22	8.34	-	0
18	4.46	3.72	3.33	0.22	9.91	-	0
19	4.23	3.68	3.13	0.24	6.89	-	-
20	4.08	3.47	3.16	0.22	8.49	-	1
21	4.3	3.3	3.47	0.22	6.81	-	0.5
22	4.2	3.5	3.4	0.27	6.08	-	0.5
23	3.6	3.08	4.12	0.25	7.23	-	0.5
24	4.4	4.67	6.16	0.27	4.29	-	0.5
25	5.8	3.65	3.55	0.31	4.88	-	0.5
26	4.2	3.88	4.42	0.42	5.8	-	0.2
27	3.58	3.28	3.3	0.36	4.9	-	1
28	3.33	2.98	2.77	0.29	5.02	-	1
29	2.9	2.6	3.93	0.26	5.31	-	1
30	2.75	3.76	12.07	0.36	4.41	-	0
31	2.4	2.22	2.14	0.58	4.59	-	0

TABLE 2.3 : PARTICULATE REMOVAL PROFILE. (APRIL/1984)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
1	3.7	2.84	2.92	0.72	6.82	-	0
2	3.2	2.67	2.67	0.36	7.03	-	0
3	4.4	3.36	3.27	0.31	5.2	_	0
4	6.3	3.95	3.87	0.4	5.83	-	0.02
5	5.5	4.05	4.4	0.62	6.39	-	0.01
6	3.68	3.07	4.2	0.63	6.42	-	0
7	3.23	2.32	3.43	0.47	6.03	-	0.2
8	5.21	3.48	3.54	0.3	6.12	-	0.2
9	8.41	6.57	6.42	0.41	7.18	-	1
10	5.72	3.97	4.05	0.43	7.99	-	1
11	6.13	3.75	3.73	0.31	8.84	-	2.8
12	5.05	3.22	3.25	0.3	4.07	-	3
13	4.25	2.77	2.77	0.2	5.59	-	3
14	4.8	3.3	3.7	0.31	6.18	-	3
15	3.75	2.97	2.77	0.28	5.34	-	3

TABLE 2.3 : PARTICULATE REMOVAL PROFILE. (APRIL/1984)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
16	3.8	3.4	4.58	0.29	7.18	-	3
17	7	3.52	3.46	0.31	8.31	-	3
18	4.25	3.18	2.7	0.31	7.15	-	3
19	3.45	2.97	2.98	0.27	6.27	-	3.9
20	3.45	3.22	2.58	0.26	7.76	-	3
21	3.32	2.35	2.2	0.17	6.77	-	4
22	3.03	2.12	2.27	0.18	6.16	-	3.8
23	3.8	1.73	2.03	0.3	7.28	-	3.8
24	3.52	2.23	2.1	0.2	6.6	-	3.8
25	5.92	2.72	2.7	0.21	7.13	-	4.5
26	6.7	3.75	3.15	0.21	7.07	-	5
27	6	3.07	3.02	0.25	6.67	-	5
28	5.5	2.55	2.52	0.19	7.7	-	5
29	4.7	2.62	3	0.2	7.42	-	5.6
30	8.75	3.45	3.72	0.25	4.58	-	6.2
31	-	-	-	-	-	-	-

TABLE 2.3 : PARTICULATE REMOVAL PROFILE. (JULY/1984)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
1	1.85	1.21	1.11	0.17	6.3	-	19
2	2.5	1.28	1.15	0.2	6.89	-	19
3	2.1	1.36	1.4	0.23	6.64	-	19.5
4	2	1.4	1.43	0.21	4.95	-	19.5
5	2.1	1.2	1.25	0.24	6.04	-	19
6	1.95	1.1	1.23	0.31	5.34	-	19
7	2.4	1.26	1.25	0.28	5.64	-	19
8	2.4	1.56	1.66	0.34	5.43	-	19
9	1.9	1.46	1.45	0.32	5.51	-	19
10	2.9	1.33	1.5	0.43	6.33	-	19
11	3.5	1.47	1.55	0.41	8.28	-	20
12	3.4	1.21	1.95	0.43	8.29	-	20
13	2.9	1.48	1.41	0.37	8.12	-	20
14	2.7	1.5	1.63	0.31	9.14	-	20
15	2.7	1.21	1.16	0.31	10.96	-	20

TABLE 2.3 : PARTICULATE REMOVAL PROFILE. (JULY/1984)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
16	4.6	1.35	1.38	0.24	10.48	-	20
17	6.2	1.96	1.93	0.18	6.29	-	21
18	3.63	2	1.85	0.2	6.62	-	21
19	2.73	1.7	1.71	0.2	6.91	-	21
20	3.22	1.61	1.68	0.23	8.52	-	21.1
21	3	1.38	1.31	0.19	6.68	-	21.1
22	2	1.23	1.11	0.2	7.23	-	21.1
23	2.1	1.38	1.91	0.21	7.37	-	22.5
24	3.2	1.63	1.56	0.18	6.55	-	22.5
25	3.6	1.7	1.63	0.19	8.27	-	22.2
26	2	1.4	1.61	0.22	6.65	-	22
27	2.25	1.36	1.75	0.23	6.42	-	22
28	1.98	1.26	1.53	0.2	7.15	-	22
29	2.68	1.45	1.85	0.24	6.89	-	22
30	3.37	1.66	1.8	0.22	6.66	-	22
31	3.08	1.68	1.83	0.23	6.96	-	22

TABLE 2.3 : PARTICULATE REMOVAL PROFILE (OCTOBER/1984)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
1	2.18	1.2	1.35	0.3	5.25	-	18
2	2.06	1.03	1.13	0.29	4.76	-	16.9
3	5.05	1.37	1.58	0.25	5.19	-	16
4	5.7	1.67	1.85	0.25	4.23	-	15.5
5	5.15	2.7	2.4	0.36	4.77	-	15
6	3.31	2.02	1.82	0.3	3.07	-	15
7	2.85	1.7	1.58	0.34	4.35	-	15
8	4.63	2.12	2.03	0.3	4.2	-	15
9	5.15	1.77	1.85	0.3	4.38	-	15
10	3.03	1.3	1.43	0.29	3.51	-	15
11	2.67	1.7	2.73	0.31	4.83	-	15
12	2.8	1.82	4.16	0.35	5.62	-	15.5
13	2.5	1.08	1.18	0.37	4.47	-	15.5
14	2.4	1.18	2.02	0.32	4.14	-	15.25
15	2.3	1.3	1.53	0.41	4.62	-	15.25

TABLE 2.3 : PARTICULATE REMOVAL PROFILE. (OCTOBER/1984)

DATE	TURBIDITY (NTU)				COAGULANT	COAG. AID	TEMP.
	Raw	East Set.	West Set.	Treat.	mg/l	mg/l	(oC)
16	2.3	1.27	1.47	0.38	4.77	-	15.5
17	2.2	1.17	1.42	0.3	4.2	-	15.5
18	1.8	1.02	1.3	0.34	4.43	-	15.8
19	1.65	1.03	1.27	0.33	3.77	-	15.6
20	2.9	1.38	1.77	0.26	5.1	-	15.5
21	2.75	1.42	1.7	0.29	4.5	-	15.4
22	2.98	1.42	1.48	0.39	4.32	-	15.2
23	2.51	1.27	1.3	0.28	4.97	-	15
24	2.21	1.45	1.86	0.36	4.16	-	15
25	1.78	1.22	1.3	0.27	4.21	-	14.9
26	1.55	1.03	1.12	0.31	4.2	-	15
27	2.2	1.05	1.27	0.33	3.92	-	15
28	2.45	1.1	1.25	0.29	3.63	-	15
29	2.9	1.28	1.55	0.38	3.88	-	15
30	2.95	1.33	1.58	0.28	3.4	-	15
31	2.9	1.87	1.97	0.38	3.38	-	14.9

TABLE 3
WATER PLANT OPTIMIZATION STUDY
"DISINFECTION SUMMARY"

TABLE 3.0: DISINFECTION SUMMARY ROSEHILL ROAD WTP MOE WPOS PROTOCOL

		1986						1985						1984					
		PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION		
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG
JAN	Cl2 Demand	1.29	0.30	0.78				3.37	0.55	1.05				6.27	0.33	0.96			
	Cl2 Dosage	1.84	0.82	1.30				3.88	1.06	1.57				2.47	0.86	1.46			
	Ammonia	-	-	-				-	-	-				-	-	-			
	SO2	-	-	-				-	-	-				-	-	-			
	Residual Cl2 Free	0.15	0.08	0.11	0.45	0.26	0.37	0.17	0.05	0.11	0.48	0.32	0.37	0.23	0.03	0.09	0.44	0.28	0.37
	Residual Cl2 Combined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Residual Cl2 Total	-	-	-	0.63	0.39	0.51	-	-	-	0.62	0.43	0.52	-	-	-	0.57	0.4	0.49
FEB	Cl2 Demand	0.97	0.28	0.57				1.27	0.14	0.73				N/A	N/A	N/A			
	Cl2 Dosage	1.42	0.76	1.03				1.78	0.84	1.23				4.53	0.80	1.44			
	Ammonia	-	-	-				-	-	-				-	-	-			
	SO2	-	-	-				-	-	-				-	-	-			
	Residual Cl2 Free	0.21	0.11	0.18	0.41	0.28	0.33	0.24	0.08	0.13	0.47	0.22	0.34	N/A	N/A	N/A	N/A	N/A	N/A
	Residual Cl2 Combined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
	Residual Cl2 Total	-	-	-	0.53	0.39	0.46	-	-	-	0.61	0.35	0.49	-	-	-	N/A	N/A	N/A
MAR	Cl2 Demand	2.40	0.30	0.81				1.15	0.30	0.75				N/A	N/A	N/A			
	Cl2 Dosage	2.82	0.75	1.26				1.65	0.83	1.27				N/A	N/A	N/A			
	Ammonia	-	-	-				-	-	-				-	-	-			
	SO2	-	-	-				-	-	-				-	-	-			
	Residual Cl2 Free	0.23	0.13	0.18	0.41	0.25	0.32	0.23	0.09	0.14	0.50	0.29	0.37	0.19	0.04	0.11	0.39	0.21	0.29
	Residual Cl2 Combined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Residual Cl2 Total	-	-	-	0.55	0.38	0.45	-	-	-	0.65	0.40	0.52	-	-	-	0.54	0.32	0.41
APR	Cl2 Demand	1.84	0.26	0.79				1.13	0.14	0.69				1.59	0.57	0.78			
	Cl2 Dosage	2.29	0.66	1.25				1.66	0.67	1.21				2.11	0.85	1.23			
	Ammonia	-	-	-				-	-	-				-	-	-			
	SO2	-	-	-				-	-	-				-	-	-			
	Residual Cl2 Free	0.21	0.13	0.18	0.41	0.26	0.34	0.21	0.08	0.13	0.41	0.29	0.36	0.22	0.07	0.11	0.37	0.26	0.31
	Residual Cl2 Combined	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Residual Cl2 Total				0.55	0.38	0.47	-	-	-	0.58	0.45	0.51	-	-	-	0.52	0.38	0.45

Table 3.0 cont'd

		1986						1985						1984					
		PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION		
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG
MAY	Cl2 Demand	1.74	0.59	1.12				N/A	N/A	N/A				1.55	0.51	0.88			
	Cl2 Dosage	2.09	1.02	1.55				N/A	N/A	N/A				1.96	0.85	1.30			
	Ammonia	-	-	-				-	-	-				-	-	-			
	SO2	-	-	-				-	-	-				-	-	-			
	Residual Cl2 Free	0.26	0.13	0.17	0.42	0.22	0.31	0.14	0.06	0.10	0.35	0.19	0.27	0.12	0.05	0.08	0.32	0.19	0.27
	Residual Cl2 Combined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Residual Cl2 Total	-	-	-	0.56	0.32	0.43	-	-	-	0.48	0.33	0.42	-	-	-	0.48	0.34	0.42
JUN	Cl2 Demand	2.21	0.83	1.37				1.57	0.73	1.18				1.88	0.68	1.19			
	Cl2 Dosage	2.67	1.43	1.85				2.20	1.14	1.60				2.36	1.06	1.68			
	Ammonia	-	-	-				-	-	-				-	-	-			
	SO2	-	-	-				-	-	-				-	-	-			
	Residual Cl2 Free	0.28	0.14	0.18	0.46	0.24	0.34	0.14	0.06	0.10	0.38	0.19	0.27	0.13	0.05	0.09	0.55	0.11	0.30
	Residual Cl2 Combined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Residual Cl2 Total	-	-	-	0.60	0.36	0.48	-	-	-	0.54	0.32	0.41	-	-	-	0.70	0.22	0.43
JUL	Cl2 Demand	2.35	0.86	1.79				1.74	0.86	1.14				1.83	0.86	1.25			
	Cl2 Dosage	2.83	1.40	2.27				2.10	1.29	1.55				2.15	1.32	1.70			
	Ammonia	-	-	-				-	-	-				-	-	-			
	SO2	-	-	-				-	-	-				-	-	-			
	Residual Cl2 Free	0.23	0.07	0.17	0.44	0.28	0.35	0.16	0.09	0.12	0.42	0.16	0.25	0.12	0.04	0.07	0.39	0.22	0.30
	Residual Cl2 Combined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Residual Cl2 Total	-	-	-	0.60	0.41	0.48	-	-	-	0.57	0.26	0.38	-	-	-	0.57	0.34	0.45
AUG	Cl2 Demand	2.64	1.32	1.89				2.95	0.43	1.27				N/A	N/A	N/A			
	Cl2 Dosage	3.09	1.81	2.40				3.33	0.84	1.68				N/A	N/A	N/A			
	Ammonia	-	-	-				-	-	-				-	-	-			
	SO2	-	-	-				-	-	-				-	-	-			
	Residual Cl2 Free	0.28	0.13	0.20	0.42	0.31	0.37	0.17	0.10	0.14	0.34	0.10	0.26	0.19	0.10	0.15	0.43	0.23	0.32
	Residual Cl2 Combined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Residual Cl2 Total	-	-	-	0.57	0.43	0.51	-	-	-	0.51	0.24	0.42	-	-	-	0.60	0.38	0.48

Table 3.0 cont'd

		1986						1985						1984					
		PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION		
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG
SEP	Cl2 Demand	3.43	0.63	1.44				1.78	1.03	1.34				2.05	0.65	1.34			
	Cl2 Dosage	3.87	1.00	1.92				2.16	1.44	1.72				2.57	1.04	1.78			
	Ammonia	-	-	-				-	-	-				-	-	-			
	SO2	-	-	-				-	-	-				-	-	-			
	Residual Cl2 Free	0.32	0.17	0.22	0.41	0.18	0.32	0.17	0.09	0.13	0.26	0.17	0.23	0.18	0.05	0.12	0.40	0.21	0.30
	Residual Cl2 Combined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Residual Cl2 Total	-	-	-	0.58	0.30	0.48	-	-	-	0.42	0.30	0.36	-	-	-	0.56	0.36	0.45
OCT	Cl2 Demand	1.81	0.46	1.31				2.29	0.79	1.37				1.64	0.7	1.18			
	Cl2 Dosage	2.27	0.87	1.78				2.62	1.15	1.76				2.10	1.09	1.63			
	Ammonia	-	-	-				-	-	-				-	-	-			
	SO2	-	-	-				-	-	-				-	-	-			
	Residual Cl2 Free	0.31	0.14	0.20	0.43	0.23	0.31	0.16	0.12	0.14	0.28	0.19	0.24	0.16	0.04	0.10	0.37	0.20	0.28
	Residual Cl2 Combined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Residual Cl2 Total	-	-	-	0.59	0.39	0.47	-	-	-	0.44	0.32	0.39	-	-	-	0.58	0.38	0.44
NOV	Cl2 Demand	1.77	0.46	1.16				1.74	0.57	1.18				1.84	0.62	1.22			
	Cl2 Dosage	2.29	0.93	1.68				2.26	1.09	1.64				2.34	1.13	1.70			
	Ammonia	-	-	-				-	-	-				-	-	-			
	SO2	-	-	-				-	-	-				-	-	-			
	Residual Cl2 Free	0.31	0.15	0.21	0.50	0.28	0.36	0.16	0.09	0.13	0.46	0.21	0.29	0.12	0.03	0.08	0.42	0.21	0.30
	Residual Cl2 Combined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Residual Cl2 Total	-	-	-	0.72	0.44	0.52	-	-	-	0.67	0.32	0.45	-	-	-	0.58	0.35	0.48
DEC	Cl2 Demand	1.36	0.35	0.74				1.56	0.43	1.02				1.86	0.52	1.17			
	Cl2 Dosage	1.83	0.84	1.21				1.75	0.85	1.50				2.39	1.00	1.69			
	Ammonia	-	-	-				-	-	-				-	-	-			
	SO2	-	-	-				-	-	-				-	-	-			
	Residual Cl2 Free	0.34	0.13	0.20	0.46	0.27	0.33	0.15	0.07	0.11	0.48	0.17	0.34	0.14	0.05	0.08	0.46	0.27	0.35
	Residual Cl2 Combined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Residual Cl2 Total	-	-	-	0.61	0.40	0.48	-	-	-	0.63	0.31	0.48	-	-	-	0.65	0.41	0.52

TABLE 3.1 : DISINFECTION PROFILE (JANUARY 1986)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
1	0.38	1.43	0.13	N/A	N/A	0.41	N/A	0.55
2	0.78	1.32	0.11	N/A	N/A	0.42	N/A	0.54
3	0.49	1	0.08	N/A	N/A	0.35	N/A	0.51
4	0.85	1.37	0.13	N/A	N/A	0.35	N/A	0.52
5	0.84	1.39	0.11	N/A	N/A	0.37	N/A	0.55
6	1.29	1.84	0.11	N/A	N/A	0.39	N/A	0.55
7	1.14	1.75	0.15	N/A	N/A	0.45	N/A	0.61
8	0.53	1.14	0.14	N/A	N/A	0.44	N/A	0.61
9	0.52	1.04	0.13	N/A	N/A	0.39	N/A	0.52
10	0.91	1.43	0.12	N/A	N/A	0.38	N/A	0.52
11	0.97	1.47	0.13	N/A	N/A	0.38	N/A	0.5
12	0.67	1.19	0.12	N/A	N/A	0.39	N/A	0.52
13	0.6	1.11	0.12	N/A	N/A	0.4	N/A	0.51
14	0.83	1.4	0.12	N/A	N/A	0.37	N/A	0.51
15	0.3	1.46	0.11	N/A	N/A	0.45	N/A	0.63

TABLE 3.1 : DISINFECTION PROFILE (JANUARY 1986) (cont'd)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
16	0.42	0.81	0.1	N/A	N/A	0.37	N/A	0.51
17	0.55	0.94	0.1	N/A	N/A	0.26	N/A	0.39
18	0.87	1.29	0.1	N/A	N/A	0.3	N/A	0.42
19	0.87	1.3	0.09	N/A	N/A	0.32	N/A	0.44
20	0.8	1.44	0.1	N/A	N/A	0.4	N/A	0.5
21	0.93	1.27	0.09	N/A	N/A	0.38	N/A	0.51
22	0.83	1.56	0.08	N/A	N/A	0.31	N/A	0.44
23	1.12	1.47	0.09	N/A	N/A	0.29	N/A	0.44
24	0.98	0.82	0.09	N/A	N/A	0.34	N/A	0.49
25	0.36	1.12	0.1	N/A	N/A	0.31	N/A	0.46
26	0.67	1.74	0.1	N/A	N/A	0.3	N/A	0.45
27	1.27	1.49	0.11	N/A	N/A	0.31	N/A	0.47
28	1.04	1.35	0.09	N/A	N/A	0.32	N/A	0.45
29	0.84	1.05	0.08	N/A	N/A	0.35	N/A	0.51
30	0.47	1.31	0.09	N/A	N/A	0.42	N/A	0.58
31	0.49	1.05	0.11	N/A	N/A	0.4	N/A	0.56

TABLE 3.1 : DISINFECTION PROFILE (APRIL 1986)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
1	0.58	1.07	0.16	N/A	N/A	0.34	N/A	0.49
2	0.64	1.11	0.18	N/A	N/A	0.36	N/A	0.47
3	0.81	1.28	0.19	N/A	N/A	0.36	N/A	0.47
4	0.81	1.29	0.17	N/A	N/A	0.35	N/A	0.48
5	1.07	1.55	0.21	N/A	N/A	0.34	N/A	0.48
6	1.03	1.43	0.14	N/A	N/A	0.27	N/A	0.4
7	0.26	0.66	0.17	N/A	N/A	0.33	N/A	0.48
8	0.67	1.15	0.19	N/A	N/A	0.34	N/A	0.48
9	0.8	1.31	0.2	N/A	N/A	0.38	N/A	0.51
10	0.72	1.18	0.17	N/A	N/A	0.33	N/A	0.46
11	0.74	1.22	0.2	N/A	N/A	0.35	N/A	0.48
12	0.7	1.22	0.16	N/A	N/A	0.37	N/A	0.52
13	1.84	2.29	0.19	N/A	N/A	0.32	N/A	0.45
14	0.57	1.04	0.17	N/A	N/A	0.35	N/A	0.47
15	0.76	1.28	0.2	N/A	N/A	0.37	N/A	0.52

TABLE 3.1 : DISINFECTION PROFILE (APRIL 1986) (cont'd)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
16	0.79	1.34	0.19	N/A	N/A	0.41	N/A	0.55
17	0.38	0.91	0.2	N/A	N/A	0.4	N/A	0.53
18	0.56	1.04	0.19	N/A	N/A	0.37	N/A	0.48
19	0.66	1.14	0.18	N/A	N/A	0.35	N/A	0.48
20	0.88	1.34	0.2	N/A	N/A	0.32	N/A	0.46
21	0.84	1.32	0.21	N/A	N/A	0.35	N/A	0.48
22	1.36	1.81	0.2	N/A	N/A	0.33	N/A	0.45
23	0.79	1.25	0.18	N/A	N/A	0.33	N/A	0.46
24	0.69	1.15	0.17	N/A	N/A	0.33	N/A	0.46
25	0.91	1.37	0.16	N/A	N/A	0.31	N/A	0.46
26	0.39	0.84	0.18	N/A	N/A	0.32	N/A	0.45
27	0.95	1.39	0.17	N/A	N/A	0.33	N/A	0.44
28	0.42	0.85	0.17	N/A	N/A	0.32	N/A	0.43
29	0.89	1.34	0.18	N/A	N/A	0.34	N/A	0.45
30	0.97	1.35	0.13	N/A	N/A	0.26	N/A	0.38
31	-	-	-	N/A	N/A	-	N/A	-

TABLE 3.1 : DISINFECTION PROFILE (JULY 1986)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
1	1.51	2.11	0.22	N/A	N/A	0.43	N/A	0.6
2	1.21	1.8	0.23	N/A	N/A	0.43	N/A	0.59
3	0.86	1.4	0.18	N/A	N/A	0.41	N/A	0.54
4	1.08	1.58	0.2	N/A	N/A	0.37	N/A	0.5
5	1.37	1.92	0.21	N/A	N/A	0.4	N/A	0.55
6	0.94	1.53	0.19	N/A	N/A	0.44	N/A	0.59
7	1.61	2.14	0.17	N/A	N/A	0.39	N/A	0.53
8	1.62	2.04	0.17	N/A	N/A	0.32	N/A	0.42
9	1.49	1.94	0.12	N/A	N/A	0.33	N/A	0.45
10	1.93	2.42	0.2	N/A	N/A	0.35	N/A	0.49
11	1.2	1.62	0.23	N/A	N/A	0.34	N/A	0.42
12	2.17	2.68	0.2	N/A	N/A	0.33	N/A	0.51
13	1.8	2.26	0.21	N/A	N/A	0.35	N/A	0.46
14	2.13	2.58	0.14	N/A	N/A	0.32	N/A	0.45
15	1.81	2.28	0.08	N/A	N/A	0.35	N/A	0.47

TABLE 3.1 : DISINFECTION PROFILE (JULY 1986) (cont'd)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
16	1.96	2.48	0.12	N/A	N/A	0.37	N/A	0.52
17	1.82	2.34	0.15	N/A	N/A	0.36	N/A	0.52
18	1.73	2.25	0.23	N/A	N/A	0.37	N/A	0.52
19	2.35	2.83	0.22	N/A	N/A	0.35	N/A	0.48
20	1.79	2.26	0.21	N/A	N/A	0.35	N/A	0.47
21	2.27	2.69	0.11	N/A	N/A	0.3	N/A	0.42
22	2.05	2.47	0.07	N/A	N/A	0.3	N/A	0.42
23	2.13	2.54	0.13	N/A	N/A	0.3	N/A	0.41
24	2.19	2.62	0.14	N/A	N/A	0.31	N/A	0.43
25	2.06	2.55	0.16	N/A	N/A	0.36	N/A	0.49
26	2.09	2.51	0.13	N/A	N/A	0.28	N/A	0.42
27	2.15	2.62	0.18	N/A	N/A	0.32	N/A	0.47
28	1.78	2.25	0.15	N/A	N/A	0.33	N/A	0.47
29	1.89	2.34	0.14	N/A	N/A	0.3	N/A	0.45
30	2.33	2.75	0.18	N/A	N/A	0.3	N/A	0.42
31	2.13	2.56	0.2	N/A	N/A	0.32	N/A	0.43

TABLE 3.1 : DISINFECTION PROFILE (OCTOBER 1986)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
1	1.46	1.92	0.15	N/A	N/A	0.32	N/A	0.46
2	1.15	1.63	0.21	N/A	N/A	0.34	N/A	0.48
3	1.03	1.5	0.19	N/A	N/A	0.33	N/A	0.47
4	1.81	2.27	0.21	N/A	N/A	0.28	N/A	0.46
5	1.19	1.67	0.21	N/A	N/A	0.31	N/A	0.48
6	1.73	2.19	0.19	N/A	N/A	0.3	N/A	0.46
7	1.08	1.55	0.23	N/A	N/A	0.34	N/A	0.47
8	1.24	1.74	0.29	N/A	N/A	0.32	N/A	0.5
9	1.73	2.26	0.2	N/A	N/A	0.35	N/A	0.53
10	1.27	1.83	0.23	N/A	N/A	0.37	N/A	0.56
11	0.73	1.32	0.31	N/A	N/A	0.43	N/A	0.59
12	0.76	1.35	0.25	N/A	N/A	0.42	N/A	0.59
13	1.29	1.78	0.24	N/A	N/A	0.33	N/A	0.49
14	1.36	1.77	0.21	N/A	N/A	0.27	N/A	0.41
15	1.61	2.02	0.17	N/A	N/A	0.23	N/A	0.41

TABLE 3.1 : DISINFECTION PROFILE (OCTOBER 1986) (cont'd)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
16	1.59	2.04	0.2	N/A	N/A	0.26	N/A	0.45
17	1.45	1.95	0.25	N/A	N/A	0.29	N/A	0.5
18	1.37	1.94	0.23	N/A	N/A	0.36	N/A	0.57
19	0.85	1.37	0.25	N/A	N/A	0.34	N/A	0.52
20	1.23	1.64	0.14	N/A	N/A	0.26	N/A	0.41
21	1.05	1.45	0.16	N/A	N/A	0.28	N/A	0.43
22	1.46	1.9	0.16	N/A	N/A	0.26	N/A	0.4
23	1.21	1.65	0.18	N/A	N/A	0.3	N/A	0.44
24	1.53	1.97	0.18	N/A	N/A	0.27	N/A	0.44
25	1.71	2.15	0.15	N/A	N/A	0.26	N/A	0.44
26	0.46	0.87	0.18	N/A	N/A	0.3	N/A	0.46
27	1.34	1.77	0.17	N/A	N/A	0.33	N/A	0.43
28	1.58	1.98	0.15	N/A	N/A	0.3	N/A	0.4
29	1.46	1.87	0.16	N/A	N/A	0.28	N/A	0.41
30	1.81	2.21	0.17	N/A	N/A	0.29	N/A	0.4
31	1.17	1.56	0.15	N/A	N/A	0.28	N/A	0.39

TABLE 3.2 : OISINFECTION PROFILE (JANUARY 1985)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
1	1.03	1.5	0.09	N/A	N/A	0.33	N/A	0.47
2	1.3	1.84	0.11	N/A	N/A	0.42	N/A	0.54
3	0.55	1.08	0.08	N/A	N/A	0.42	N/A	0.53
4	0.59	1.08	0.09	N/A	N/A	0.35	N/A	0.49
5	0.72	1.21	0.11	N/A	N/A	0.35	N/A	0.49
6	1.11	1.59	0.15	N/A	N/A	0.37	N/A	0.48
7	1.05	1.57	0.09	N/A	N/A	0.38	N/A	0.52
8	1.42	1.9	0.09	N/A	N/A	0.35	N/A	0.48
9	1.16	1.66	0.08	N/A	N/A	0.34	N/A	0.5
10	0.87	1.3	0.14	N/A	N/A	0.3	N/A	0.43
11	0.78	1.34	0.12	N/A	N/A	0.37	N/A	0.56
12	1.08	1.62	0.13	N/A	N/A	0.38	N/A	0.54
13	0.82	1.38	0.17	N/A	N/A	0.37	N/A	0.56
14	1.11	1.62	0.15	N/A	N/A	0.33	N/A	0.52
15	3.37	3.88	0.15	N/A	N/A	0.32	N/A	0.51

TABLE 3.2 : DISINFECTION PROFILE (JANUARY 1985) (cont'd)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
16	N/A	N/A	0.15	N/A	N/A	0.35	N/A	0.56
17	1.53	2.02	0.13	N/A	N/A	0.35	N/A	0.49
18	1.04	1.53	0.06	N/A	N/A	0.32	N/A	0.49
19	0.9	1.44	0.05	N/A	N/A	0.35	N/A	0.5
20	1.74	2.28	0.06	N/A	N/A	0.4	N/A	0.54
21	1.45	*2.01	0.15	N/A	N/A	0.36	N/A	0.56
22	0.59	1.06	0.14	N/A	N/A	0.35	N/A	0.47
23	0.6	1.11	0.13	N/A	N/A	0.37	N/A	0.51
24	0.83	1.36	0.14	N/A	N/A	0.37	N/A	0.53
25	0.68	1.19	0.12	N/A	N/A	0.37	N/A	0.51
26	0.85	1.35	0.1	N/A	N/A	0.36	N/A	0.5
27	0.99	1.58	0.1	N/A	N/A	0.44	N/A	0.59
28	0.8	1.42	0.1	N/A	N/A	0.47	N/A	0.62
29	1.04	1.65	0.11	N/A	N/A	0.48	N/A	0.61
30	0.65	1.21	0.1	N/A	N/A	0.44	N/A	0.56
31	0.77	1.33	0.13	N/A	N/A	0.43	N/A	0.56

TABLE 3.2 : DISINFECTION PROFILE (APRIL 1985)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
1	0.53	1.1	0.21	N/A	N/A	0.41	N/A	0.57
2	0.61	1.14	0.14	N/A	N/A	0.35	N/A	0.53
3	0.63	1.06	0.15	N/A	N/A	0.31	N/A	0.43
4	0.48	1.02	0.12	N/A	N/A	0.39	N/A	0.54
5	0.14	0.67	0.13	N/A	N/A	0.35	N/A	0.53
6	0.67	1.22	0.12	N/A	N/A	0.37	N/A	0.55
7	1.13	1.66	0.11	N/A	N/A	0.36	N/A	0.53
8	1.08	1.66	0.12	N/A	N/A	0.41	N/A	0.58
9	0.87	1.43	0.13	N/A	N/A	0.41	N/A	0.56
10	0.76	1.32	0.12	N/A	N/A	0.39	N/A	0.56
11	0.54	1.08	0.13	N/A	N/A	0.39	N/A	0.54
12	0.32	0.86	0.12	N/A	N/A	0.4	N/A	0.54
13	0.46	0.98	0.19	N/A	N/A	0.35	N/A	0.52
14	0.41	0.86	0.12	N/A	N/A	0.31	N/A	0.45
15	0.63	1.08	0.08	N/A	N/A	0.29	N/A	0.45

TABLE 3.2 : DISINFECTION PROFILE (APRIL 1985) (cont'd)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
16	0.82	1.3	0.09	N/A	N/A	0.32	N/A	0.48
17	0.94	1.41	0.11	N/A	N/A	0.31	N/A	0.47
18	0.88	1.36	0.12	N/A	N/A	0.31	N/A	0.48
19	0.62	1.15	0.14	N/A	N/A	0.39	N/A	0.53
20	0.65	1.21	0.14	N/A	N/A	0.44	N/A	0.56
21	1.07	1.61	0.15	N/A	N/A	0.4	N/A	0.54
22	0.24	0.78	0.15	N/A	N/A	0.39	N/A	0.54
23	0.95	1.44	0.15	N/A	N/A	0.36	N/A	0.49
24	0.9	1.4	0.12	N/A	N/A	0.34	N/A	0.5
25	0.89	1.34	0.11	N/A	N/A	0.31	N/A	0.45
26	0.66	1.17	0.15	N/A	N/A	0.34	N/A	0.51
27	0.64	1.12	0.14	N/A	N/A	0.33	N/A	0.48
28	1.09	1.58	0.11	N/A	N/A	0.35	N/A	0.49
29	0.65	1.1	0.14	N/A	N/A	0.3	N/A	0.45
30	0.61	1.06	0.14	N/A	N/A	0.31	N/A	0.45
31	-	-	-	-	-	-	-	-

TABLE 3.2 : DISINFECTION PROFILE (JULY 1985)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
1	1.02	1.43	0.11	N/A	N/A	0.25	N/A	0.41
2	0.87	1.29	0.11	N/A	N/A	0.25	N/A	0.42
3	1.1	1.54	0.13	N/A	N/A	0.26	N/A	0.44
4	1.04	1.45	0.09	N/A	N/A	0.24	N/A	0.41
5	0.97	1.38	0.12	N/A	N/A	0.27	N/A	0.41
6	1.16	1.55	0.1	N/A	N/A	0.22	N/A	0.39
7	1.3	1.7	0.1	N/A	N/A	0.21	N/A	0.4
8	1.09	1.35	0.13	N/A	N/A	0.16	N/A	0.26
9	1.34	1.73	0.1	N/A	N/A	0.25	N/A	0.39
10	1.46	1.82	0.12	N/A	N/A	0.19	N/A	0.36
11	1.34	1.7	0.12	N/A	N/A	0.23	N/A	0.36
12	1	1.4	0.12	N/A	N/A	0.24	N/A	0.4
13	0.92	1.33	0.14	N/A	N/A	0.26	N/A	0.41
14	0.9	1.29	0.13	N/A	N/A	0.22	N/A	0.39
15	1.31	1.66	0.12	N/A	N/A	0.18	N/A	0.35

TABLE 3.2 : DISINFECTION PROFILE (JULY 1985) (cont'd)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
16	1.74	2.1	0.11	N/A	N/A	0.21	N/A	0.36
17	1.19	1.57	0.16	N/A	N/A	0.22	N/A	0.38
18	1.23	1.55	0.13	N/A	N/A	0.16	N/A	0.32
19	1.11	1.47	0.1	N/A	N/A	0.16	N/A	0.36
20	1.27	1.64	0.12	N/A	N/A	0.25	N/A	0.37
21	1.23	1.67	0.14	N/A	N/A	0.3	N/A	0.44
22	1.26	1.73	0.12	N/A	N/A	0.25	N/A	0.47
23	1.45	1.88	0.14	N/A	N/A	0.28	N/A	0.43
24	1.14	1.71	0.13	N/A	N/A	0.42	N/A	0.57
25	0.97	1.39	0.13	N/A	N/A	0.3	N/A	0.42
26	1.14	1.58	0.13	N/A	N/A	0.31	N/A	0.44
27	1.04	1.53	0.15	N/A	N/A	0.3	N/A	0.49
28	0.94	1.44	0.15	N/A	N/A	0.31	N/A	0.50
29	0.88	1.38	0.16	N/A	N/A	0.33	N/A	0.50
30	0.86	1.31	0.15	N/A	N/A	0.3	N/A	0.45
31	1.09	1.52	0.15	N/A	N/A	0.31	N/A	0.43

TABLE 3.2 : DISINFECTION PROFILE (OCTOBER 1985)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
1	1.3	1.71	0.14	N/A	N/A	0.24	N/A	0.41
2	1.57	1.94	0.12	N/A	N/A	0.21	N/A	0.37
3	1.68	2.06	0.16	N/A	N/A	0.22	N/A	0.38
4	0.79	1.15	0.14	N/A	N/A	0.19	N/A	0.35
5	1.51	1.92	0.13	N/A	N/A	0.22	N/A	0.36
6	1.54	1.93	0.14	N/A	N/A	0.24	N/A	0.41
7	0.86	1.25	0.15	N/A	N/A	0.25	N/A	0.39
8	0.95	1.31	0.13	N/A	N/A	0.21	N/A	0.36
9	1.24	1.61	0.14	N/A	N/A	0.23	N/A	0.37
10	0.86	1.26	0.13	N/A	N/A	0.22	N/A	0.4
11	1.72	2.09	0.14	N/A	N/A	0.26	N/A	0.37
12	1.43	1.8	0.14	N/A	N/A	0.24	N/A	0.37
13	1.59	1.98	0.16	N/A	N/A	0.24	N/A	0.39
14	1.48	1.87	0.15	N/A	N/A	0.24	N/A	0.39
15	1.56	1.88	0.13	N/A	N/A	0.19	N/A	0.32

TABLE 3.2 : DISINFECTION PROFILE (OCTOBER 1985) (cont'd)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
16	2.26	2.62	0.13	N/A	N/A	0.23	N/A	0.36
17	1.41	1.80	0.13	N/A	N/A	0.24	N/A	0.39
18	0.93	1.31	0.14	N/A	N/A	0.24	N/A	0.38
19	1.09	1.45	0.14	N/A	N/A	0.20	N/A	0.36
20	1.32	1.69	0.12	N/A	N/A	0.21	N/A	0.37
21	1.13	1.51	0.15	N/A	N/A	0.22	N/A	0.38
22	0.84	1.23	0.15	N/A	N/A	0.22	N/A	0.39
23	1.30	1.69	0.15	N/A	N/A	0.23	N/A	0.39
24	1.38	1.80	0.13	N/A	N/A	0.26	N/A	0.42
25	1.52	1.96	0.13	N/A	N/A	0.28	N/A	0.44
26	1.52	1.93	0.14	N/A	N/A	0.27	N/A	0.41
27	1.49	1.93	0.13	N/A	N/A	0.26	N/A	0.44
28	1.72	2.16	0.12	N/A	N/A	0.27	N/A	0.44
29	1.46	1.89	0.12	N/A	N/A	0.26	N/A	0.43
30	1.75	2.16	0.15	N/A	N/A	0.25	N/A	0.41
31	1.23	1.66	0.15	N/A	N/A	0.25	N/A	0.43

TABLE 3.3 : DISINFECTION PROFILE (JANUARY 1984)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
1	0.53	1.04	0.11	N/A	N/A	0.38	N/A	0.51
2	0.68	1.19	0.13	N/A	N/A	0.39	N/A	0.51
3	0.63	1.11	0.08	N/A	N/A	0.34	N/A	0.48
4	0.48	0.99	0.09	N/A	N/A	0.38	N/A	0.51
5	0.91	1.4	0.09	N/A	N/A	0.38	N/A	0.49
6	0.75	1.27	0.05	N/A	N/A	0.34	N/A	0.52
7	1.07	1.59	0.1	N/A	N/A	0.35	N/A	0.51
8	0.42	0.94	0.07	N/A	N/A	0.39	N/A	0.52
9	1.86	2.4	0.07	N/A	N/A	0.41	N/A	0.52
10	1.49	1.99	0.1	N/A	N/A	0.44	N/A	0.54
11	6.27	6.8	0.09	N/A	N/A	0.37	N/A	0.5
12	1.14	1.67	0.11	N/A	N/A	0.4	N/A	0.53
13	1.96	2.47	0.16	N/A	N/A	0.39	N/A	0.51
14	1.54	2.02	0.19	N/A	N/A	0.37	N/A	0.48
15	0.63	1.2	0.16	N/A	N/A	0.43	N/A	0.57

TABLE 3.3 : DISINFECTION PROFILE (JANUARY 1984) (cont'd)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
16	0.46	1	0.1	N/A	N/A	0.41	N/A	0.54
17	0.49	1	0.08	N/A	N/A	0.35	N/A	0.51
18	0.5	1.01	0.1	N/A	N/A	0.36	N/A	0.51
19	0.9	1.42	0.23	N/A	N/A	0.42	N/A	0.52
20	0.58	1.07	0.13	N/A	N/A	0.36	N/A	0.49
21	0.52	1.02	0.07	N/A	N/A	0.35	N/A	0.5
22	0.46	0.9	0.05	N/A	N/A	0.3	N/A	0.44
23	0.51	0.92	0.05	N/A	N/A	0.3	N/A	0.41
24	0.44	0.87	0.05	N/A	N/A	0.3	N/A	0.44
25	0.55	0.95	0.03	N/A	N/A	0.28	N/A	0.4
26	0.78	1.25	0.13	N/A	N/A	0.37	N/A	0.47
27	0.5	0.99	0.08	N/A	N/A	0.37	N/A	0.49
28	0.77	1.28	0.07	N/A	N/A	0.37	N/A	0.51
29	0.33	0.86	0.09	N/A	N/A	0.38	N/A	0.53
30	0.8	1.31	0.08	N/A	N/A	0.37	N/A	0.51
31	0.85	1.36	0.14	N/A	N/A	0.38	N/A	0.51

TABLE 3.3 : DISINFECTION PROFILE (APRIL 1984)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
1	*1.02	*1.49	0.12	N/A	N/A	0.3	N/A	0.47
2	*0.66	*1.15	0.12	N/A	N/A	0.34	N/A	0.49
3	*0.64	*1.10	0.09	N/A	N/A	0.31	N/A	0.46
4	*0.75	*1.21	0.08	N/A	N/A	0.28	N/A	0.46
5	0.59	1.05	0.14	N/A	N/A	0.32	N/A	0.46
6	1.59	2.11	0.13	N/A	N/A	0.37	N/A	0.52
7	0.84	1.34	0.11	N/A	N/A	0.33	N/A	0.5
8	0.71	1.17	0.1	N/A	N/A	0.31	N/A	0.46
9	0.68	1.14	0.09	N/A	N/A	0.31	N/A	0.46
10	0.82	1.27	0.08	N/A	N/A	0.28	N/A	0.45
11	0.57	0.99	0.07	N/A	N/A	0.29	N/A	0.42
12	0.57	1.02	0.14	N/A	N/A	0.34	N/A	0.45
13	0.6	1.03	0.12	N/A	N/A	0.31	N/A	0.43
14	1.14	1.63	0.22	N/A	N/A	0.34	N/A	0.49
15	0.36	0.85	0.09	N/A	N/A	0.33	N/A	0.49

* CL2 scale defective 84/04/01 - 84/04/04

TABLE 3.3 : DISINFECTION PROFILE (APRIL 1984) (cont'd)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
16	0.7	1.1	0.1	N/A	N/A	0.27	N/A	0.4
17	1.04	1.42	0.1	N/A	N/A	0.26	N/A	0.38
18	0.93	1.38	0.22	N/A	N/A	0.31	N/A	0.45
19	0.46	0.93	0.11	N/A	N/A	0.33	N/A	0.47
20	0.94	1.4	0.1	N/A	N/A	0.3	N/A	0.46
21	0.73	1.17	0.08	N/A	N/A	0.31	N/A	0.44
22	0.71	1.13	0.08	N/A	N/A	0.27	N/A	0.42
23	0.63	1.07	0.08	N/A	N/A	0.3	N/A	0.44
24	0.87	1.31	0.11	N/A	N/A	0.3	N/A	0.44
25	0.73	1.19	0.16	N/A	N/A	0.32	N/A	0.46
26	0.97	1.42	0.14	N/A	N/A	0.31	N/A	0.45
27	0.64	1.08	0.1	N/A	N/A	0.29	N/A	0.44
28	0.64	1.06	0.09	N/A	N/A	0.27	N/A	0.42
29	0.84	1.3	0.11	N/A	N/A	0.28	N/A	0.46
30	0.97	1.47	0.11	N/A	N/A	0.33	N/A	0.5
31	-	-	-	-	-	-	-	-

TABLE 3.3 : DISINFECTION PROFILE (JULY 1984)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
1	1.68	2.15	0.1	N/A	N/A	0.36	N/A	0.47
2	0.91	1.36	0.08	N/A	N/A	0.34	N/A	0.45
3	1.14	1.49	0.07	N/A	N/A	0.22	N/A	0.35
4	1.05	1.51	0.06	N/A	N/A	0.3	N/A	0.46
5	1.16	1.6	0.05	N/A	N/A	0.28	N/A	0.44
6	1.33	1.69	0.05	N/A	N/A	0.24	N/A	0.36
7	1.29	1.74	0.05	N/A	N/A	0.29	N/A	0.45
8	1.54	2.02	0.05	N/A	N/A	0.32	N/A	0.48
9	0.98	1.53	0.04	N/A	N/A	0.36	N/A	0.55
10	1.83	2.35	0.07	N/A	N/A	0.33	N/A	0.52
11	1.28	1.76	0.09	N/A	N/A	0.35	N/A	0.48
12	1.2	1.77	0.09	N/A	N/A	0.39	N/A	0.57
13	0.88	1.39	0.12	N/A	N/A	0.31	N/A	0.51
14	0.97	1.47	0.12	N/A	N/A	0.32	N/A	0.5
15	1.65	2.15	0.11	N/A	N/A	0.33	N/A	0.5

TABLE 3.3 : DISINFECTION PROFILE (JULY 1984) (cont'd)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
16	1.3	1.85	0.09	N/A	N/A	0.39	N/A	0.55
17	0.86	1.32	0.11	N/A	N/A	0.32	N/A	0.46
18	1.47	1.85	0.07	N/A	N/A	0.27	N/A	0.38
19	1.06	1.48	0.06	N/A	N/A	0.27	N/A	0.42
20	1.24	1.67	0.07	N/A	N/A	0.3	N/A	0.43
21	0.99	1.44	0.06	N/A	N/A	0.3	N/A	0.45
22	1.19	1.58	0.1	N/A	N/A	0.27	N/A	0.39
23	1.04	1.39	0.08	N/A	N/A	0.22	N/A	0.35
24	1.29	1.68	0.06	N/A	N/A	0.26	N/A	0.39
25	1.56	1.97	0.09	N/A	N/A	0.28	N/A	0.41
26	1.04	1.52	0.06	N/A	N/A	0.32	N/A	0.48
27	1.44	1.78	0.07	N/A	N/A	0.23	N/A	0.34
28	1.42	1.83	0.06	N/A	N/A	0.27	N/A	0.41
29	1.18	1.7	0.1	N/A	N/A	0.34	N/A	0.52
30	1.4	1.91	0.1	N/A	N/A	0.34	N/A	0.51
31	1.29	1.75	0.07	N/A	N/A	0.26	N/A	0.46

TABLE 3.3 : DISINFECTION PROFILE (OCTOBER 1984)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
1	1.28	1.73	0.11	N/A	N/A	0.31	N/A	0.45
2	1.03	1.47	0.1	N/A	N/A	0.32	N/A	0.44
3	1.16	1.6	0.14	N/A	N/A	0.29	N/A	0.44
4	1.03	1.51	0.1	N/A	N/A	0.33	N/A	0.48
5	1.31	1.74	0.13	N/A	N/A	0.29	N/A	0.43
6	1.64	2.08	0.11	N/A	N/A	0.31	N/A	0.44
7	1.04	1.52	0.14	N/A	N/A	0.33	N/A	0.48
8	0.78	1.31	0.14	N/A	N/A	0.36	N/A	0.53
9	1.16	1.63	0.11	N/A	N/A	0.29	N/A	0.47
10	0.98	1.49	0.16	N/A	N/A	0.33	N/A	0.51
11	1.31	1.83	0.15	N/A	N/A	0.34	N/A	0.52
12	1.4	1.82	0.12	N/A	N/A	0.26	N/A	0.42
13	1.34	1.73	0.09	N/A	N/A	0.2	N/A	0.39
14	1.55	1.98	0.1	N/A	N/A	0.25	N/A	0.43
15	1.17	1.6	0.1	N/A	N/A	0.24	N/A	0.43

TABLE 3.3 : DISINFECTION PROFILE (OCTOBER 1984) (cont'd)

DATE	PRE - CHLORINATION					POST - CHLORINATION		
	CL2		RESIDUAL CL2			RESIDUAL CL2		
	Dem.	Dos.	Free.	Comb.	Total	Free.	Comb.	Total
16	1.14	1.57	0.12	N/A	N/A	0.28	N/A	0.43
17	1.23	1.69	0.11	N/A	N/A	0.29	N/A	0.46
18	1.12	1.65	0.16	N/A	N/A	0.34	N/A	0.53
19	1.04	1.45	0.14	N/A	N/A	0.24	N/A	0.41
20	1.29	1.68	0.12	N/A	N/A	0.24	N/A	0.39
21	1.35	1.78	0.12	N/A	N/A	0.26	N/A	0.43
22	1.58	2.01	0.11	N/A	N/A	0.27	N/A	0.43
23	1.24	1.65	0.11	N/A	N/A	0.27	N/A	0.41
24	1.63	2.1	0.14	N/A	N/A	0.24	N/A	0.38
25	1.23	1.81	0.11	N/A	N/A	0.37	N/A	0.58
26	0.99	1.47	0.08	N/A	N/A	0.34	N/A	0.48
27	0.96	1.4	0.04	N/A	N/A	0.28	N/A	0.44
28	0.96	1.37	0.05	N/A	N/A	0.27	N/A	0.41
29	1.15	1.56	0.04	N/A	N/A	0.27	N/A	0.41
30	0.88	1.3	0.04	N/A	N/A	0.3	N/A	0.42
31	0.7	1.09	0.07	N/A	N/A	0.26	N/A	0.39

TABLE 4
WATER PLANT OPTIMIZATION STUDY
"WATER QUALITY SUMMARY"

Table 4.0

PLANT Rosehill WTP MOS WATER QUALITY – 4-YEAR SUMMARY ( )

Samples Taken: 85 10 01, 83 07 05 *

GENERAL CHEMISTRY		19 86			* 19 85			19 84			* 19 83			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
GENERAL CHEMISTRY															
ALKALINITY	R				97.2		97.2				104		104	0.2	
mg/L	T				94.4		94.4				87		87	mg/L	
AMMONIUM TOTAL	R				< .05		<.05							0.05	
mg/L	T	<.05		<.05	< .05		<.05							mg/L	
CALCIUM	R				-		-							0.1	
mg/L	T				-		-							mg/L	
CHLORIDE	R				15.8		15.8				14.6		14.6	0.2	250
mg/L	T	16.2	14.9	15.8	17.2		17.2				15.8		15.8	mg/L	mg/L
COLOUR TCU	R				3.5		3.5				7.5*		7.5	0.5	5
	T				1.0		1.0				4.1*		4.1	TCU	TCU
CONDUCTIVITY	R				283		283				299		299	0.01	
umho/cm	T	304.2	274.3	282.4	290		290				303		303	UMHO/CM	
FIELD CHLORINE (COMBINED)	R													0.1	
mg/L	T													mg/L	
FIELD CHLORINE (FREE)	R													0.1	
mg/L	T													mg/L	
FIELD CHLORINE (TOTAL)	R													0.1	
mg/L	T													mg/L	
FIELD PH	R													0.2	
	T														

*Hazen-Units

PLANT Rosehill WTP

MOS
WATER QUALITY – 4-YEAR SUMMARY ( )

GENERAL CHEMISTRY (Cont'd)		1986 MAX	1986 MIN	1986 AVE	* 1985 MAX	1985 MIN	1985 AVE	1984 MAX	1984 MIN	1984 AVE	* 1983 MAX	1983 MIN	1983 AVE	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
FIELD TEMPERATURE	R														
°C	T														
FIELD TURBIDITY	R														1 FTU
FTU	T														
FLUORIDE	R				–		–				0.12		0.12	0.01	2.4
mg/L	T				–		–				0.13		0.13	mg/L	mg/L
HARDNESS	R				121		121				128.5		128.5	0.5	
mg/L	T				121		121				132.3		132.8	mg/L	
MAGNESIUM	R				–		–				8.8		8.8	0.05	
mg/L	T										8.75		8.75	mg/L	c
NITRATE	R				–		–				<0.10		<0.10	0.05	10 mg/L
mg/L	T	.38	.28	.14	–		–				0.10		0.10	mg/L	as N
NITRITE	R				.005		.005				.01		.01 T	0.005	1 mg/L
mg/L	T				.005		.005				<.01		<.01	mg/L	as N
NITROGEN TOTAL KJELDAHL	R				–						.30		.30 T	0.1	0.15
mg/L	T	.32	.26	.21	–		–				.30		.30 T	mg/L	mg/L *
PH	R				8.46		8.46				8.40		8.40		
	T				7.98		7.98				8.07		8.07		
PHOSPHORUS FILTERED REACTIVE	R				–		–							0.01	
mg/L	T	<.01	<.01	<.01	–		–							mg/L	

T-Tentative

PLANT Rosehill WTP

MPOS
WATER QUALITY - 4-YEAR SUMMARY (   )

GENERAL CHEMISTRY (Cont'd)		19 86 MAX	19 86 MIN	19 86 AVE	* 19 85 MAX	19 85 MIN	19 85 AVE	19 84 MAX	19 84 MIN	19 84 AVE	* 19 83 MAX	19 83 MIN	19 83 AVE	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
PHOSPHORUS TOTAL	R				–		–							0.01	
mg/L	T	.029	.013	.018	–		–							mg/L	
SODIUM	R				–		–				9.0		9.0	0.1	
mg/L	T				–		–				9.2		9.2	mg/L	
TOTAL SOLIDS	R													1	
mg/L	T													mg/L	
TURBIDITY	R				2.7		2.7				.97		.97	0.01	1
FTU	T				.27T		.27T				.50		.50	FTU	FTU
METALS															
ALUMINUM	R				–		–				.41		.41	0.003	
mg/L	T				–		–				.06		.06	mg/L	
ARSENIC	R				<.001		<001				<001		<.001	0.001	0.05
mg/L	T				–		–				<001		<.001	mg/L	mg/L
BARIUM	R				–		–				.018		.018	0.001	1
mg/L	T				–		–				.019		.019	mg/L	mg/L
BERYLLIUM	R				–		–				< .01		<.01	0.001	
mg/L	T				–		–				< .01		<.01	mg/L	
BORON	R				–		–							0.02	5
mg/L	T				–		–							mg/L	mg/L
CADMIUM	R				–		–				<002		<.002	0.0003	0.005
mg/L	T										<002		<.002	mg/L	mg/L

[illegible]entative, f[illegible] information o[illegible]

PLANT Rosehill WTP

MOS
WATER QUALITY - 4-YEAR SUMMARY (   )

METALS (Cont'd)			19 86			* 1985			19 84			* 19 83			DWSP DETECTION LIMIT[a]	DRINKING WATER OBJ/ GUIDELINE[1]
			MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
CHROMIUM		R				–		–				<.01		<.01	0.001	0.05
	mg/L	T				–		–				<.01		<.01	mg/L	mg/L
COBALT		R				–		–				<.01		<.01	0.001	
	mg/L	T				–		–				<.01		<.01	mg/L	
COPPER		R				–		–				.06		.06	0.001	1
	mg/L	T				–		–				.06		.06	mg/L	mg/L
CYANIDE		R				<.001		<.001				<.001		<.001	0.001	0.2
	mg/L	T				<.001		<.001				<.001		<.001	mg/L	mg/L
IRON		R				–		–				.07		.07	0.002	0.3
	mg/L	T				–		–				<.02		<.02	mg/L	mg/L c
LEAD	mg/L	R				–		–				<.03		<.03	0.003	0.05
		T				–		–				<.03		<.03	mg/L	mg/L
MANGANESE		R				–		–				.013		.013	0.001	0.05
	mg/L	T				–		–				.008		.008	mg/L	mg/L
MOLYBDENUM		R				–		–							0.001	
	mg/L	T				–		–							mg/L	
MERCURY		R				<.01		<.01				.02		.02	0.01	1
	ug/L	T				<.01		<.01				<.01		<.01	ug/L	ug/L
NICKEL		R				–		–				<.01		<.01	0.002	
	mg/L	T				–		–				<.01		<.01	mg/L	

MOS

PLANT Rosehill WTP WATER QUALITY - 4-YEAR SUMMARY ( )

METALS (Cont'd)		1986 MAX	1986 MIN	1986 AVE	* 1985 MAX	1985 MIN	1985 AVE	1984 MAX	1984 MIN	1984 AVE	* 1983 MAX	1983 MIN	1983 AVE	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
SELENIUM mg/L	R				<.001		<.001				<.001		<.001	0.001 mg/L	0.01 mg/L
	T										<.001		<.001		
STRONTIUM mg/L	R				–		–				.160		.160	0.001 mg/L	
	T				–		–				.160		.160		
TIN (no units available)	R				–		–								
	T				–		–								
URANIUM mg/L	R				–		–							0.002 mg/L	.02 mg/L t
	T				–		–								
VANADIUM mg/L	R				–		–				<.01		<.01	0.001 mg/L	
	T				–		–				<.01		<.01		
ZINC mg/L	R				–		–				<.01		<.01	0.001 mg/L	5 mg/L h
	T				–		–				<.01		<.01		
PURGEABLES															
BENZENE ug/L	R				.10		.10							1 ug/L	10 ug/L h
	T				.10		.10								
BROMOFORM ug/L	R				ND		ND							1 ug/L	350 ug/L ++
	T				.30		.30								
CARBON TETRACHLORIDE ug/L	R				ND		ND				<0.0		<0.0	1 ug/L	3 ug/L h
	T				ND		ND				<0.0		<0.0		
CHLOROBENZENE ug/L	R				ND		ND							1 ng/L	100-300 ng/L h*
	T				ND		ND								

WPOS

PLANT Rosehill, Fort Erie WATER QUALITY - 4-YEAR SUMMARY ( )

PURGEABLES (Cont'd)		1986			* 1985			1984			* 1983			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
CHLORODIBROMOMETHANE	R				ND		ND				<0.0		<0.0	1	350
ug/L	T				2.3		2.3				4.0		4.0	ug/L	ug/L ++
CHLOROFORM	R				TR		TR				<0.0		<0.0	1	350
ug/L	T				12		12				15.0		15.0	ug/L	ug/L ++
1,2-DICHLOROBENZENE	R				ND		ND							1	400
ug/L	T				ND		ND							ug/L	ug/L •
1,3-DICHLOROBENZENE	R				-		-							1	400
ug/L	T				-		-							ug/L	ug/L •
1,4-DICHLOROBENZENE	R				-		-							1	400
ug/L	T				-		-							ug/L	ug/L •
DICHLOROBROMOMETHANE	R				ND		ND							1	350
ug/L	T				4.6		4.6							ug/L	ug/L ++
1,1-DICHLOROETHANE	R				ND		ND							1	
ug/L	T				ND		ND							ug/L	
1,2-DICHLOROETHANE	R				ND		ND							1	10
ug/L	T				ND		ND							ug/L	ug/L h
1,1-DICHLOROETHYLENE	R				ND		ND							1	.3
ug/L	T				ND		ND							ug/L	ug/L h
T,1,2-DICHLOROETHYLENE	R				-		-							1	
ug/L	T				-		-							ug/L	

MOS

PLANT Rosehill WTP WATER QUALITY - 4-YEAR SUMMARY ( )

PURGEABLES (Cont'd)		1986 MAX	1986 MIN	1986 AVE	* 1985 MAX	1985 MIN	1985 AVE	1984 MAX	1984 MIN	1984 AVE	* 1983 MAX	1983 MIN	1983 AVE	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
DICHLOROMETHANE	R				–		–							5	40
ug/L	T				–		–							ug/L	ug/L c
1,2 DICHLOROPROPANE	R				ND		ND							1	
ug/L	T				ND		ND							ug/L	
ETHYLBENZENE	R				ND		ND							1	1400
ug/L	T				ND		ND							ug/L	ug/L e
ETHYLENE DIBROMIDE	R														
ug/L	T														
M-XYLENE	R				ND		ND							1	620
ug/L	T				ND		ND							ug/L	ug/L c
O-XYLENE	R				–		–							1 ug/L	620
ug/L	T				–		–								ug/L c
P-XYLENE	R				–		–							1	620
ug/L	T				–		–							ug/L	ug/L c
TOLUENE	R				.1		.1							1	100
ug/L	T				.1		.1							ug/L	ug/L c
1,1,2,2-TETRACHLOROETHANE	R				ND		ND							1	1.7
ug/L	T				ND		ND							ug/L	ug/L e
TETRACHLOROETHYLENE	R				ND		ND				<0.0		<0.0	1	10
ug/L	T				ND		ND				<0.0		<0.0	ug/L	ug/L h

PLANT Rosehill WTP

MOS
WATER QUALITY - 4-YEAR SUMMARY ( )

PURGEABLES (Cont'd)		19 86 MAX	19 86 MIN	19 86 AVE	* 1985 MAX	* 1985 MIN	* 1985 AVE	19 84 MAX	19 84 MIN	19 84 AVE	* 1983 MAX	* 1983 MIN	* 1983 AVE	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
1,1,1-TRICHLOROETHANE	R				ND		ND							1	1000
ug/L	T				ND		ND							ug/L	ug/L c
1,1,2-TRICHLOROETHANE	R				ND		ND							1	6
ug/L	T				ND		ND							ug/L	ug/L e
TRICHLOROETHYLENE	R				ND		ND				<0.0		<0.0	1	30
ug/L	T				ND		ND				<0.0		<0.0	ug/L	ug/L h
TOTAL TRIHALOMETHANES	R				-		-							3	350
ug/L	T				-		-							ug/L	ug/L ++
TRIFLUOROCHLOROTOLUENE	R				-		-							1	
ug/L	T				-		-							ug/L	
ORGANOCHLORINES															
ALDRIN	R				<1.0		<1.0				<1.0		<1.0	1	700
ng/L	T				<1.0		<1.0				<1.0		<1.0	ng/L	ng/L **
ALPHA BHC	R				4.0T		4.0				4.0		4.0	1	700
ng/L	T				3.0T		3.0				3.0		3.0	ng/L	ng/L c
ALPHA CHLORDANE	R				<2.0		<2.0				<2.0		<2.0	2	700
ng/L	T				<2.0		<2.0				<2.0		<2.0	ng/L	ng/L ***
BETA BHC	R				<1.0		<1.0				1.0		1.0	1	300
ng/L	T				<1.0		<1.0				1.0		1.0	ng/L	ng/L c
DIELDRIN	R				<2.0		<2.0				2.0		2.0	2	700
ng/L	T				<2.0		<2.0				2.0		2.0	ng/L	ng/L **

T-Tentative, for information only

PLANT Rosehill, Fort Erie WPOS WATER QUALITY - 4-YEAR SUMMARY (   )

ORGANOCHLORINES (Cont'd)		19 86			* 19 85			19 84			* 19 83			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
ENDRIN	R				<4.0		<4.0							4	200
ng/L	T				<4.0		<4.0							ng/L	ng/L
GAMMA CHLORDANE	R				<2.0		<2.0				<2.0		<2.0	2	700
ng/L	T				<2.0		<2.0				<2.0		<2.0	ng/L	ng/L ***
HEPTACHLOR EPOXIDE	R				<1.0		<1.0				<1.0		<1.0	1	3000 +++
ng/L	T				<1.0		<1.0				<1.0		<1.0	ng/L	ng/L
HEPTACHLOR	R				<1.0		<1.0				<1.0		<1.0	1	3000
ng/L	T				<1.0		<1.0				<1.0		<1.0	ng/L	ng/L +++
HEXACHLOROBENZENE	R				<1.0		<1.0				<1.0		<1.0	1	10
ng/L	T				<1.0		<1.0				<1.0		<1.0	ng/L	ng/L h
HEXACHLOROBUTADIENE	R				<1.0		<1.0								
ug/L	T				<1.0		<1.0								
HEXACHLOROETHANE	R				<1.0		<1.0							1	19000
ng/L	T				<1.0		<1.0							ng/L	ng/L e
LINDANE	R				<3.0		<3.0							1	4000
ng/L	T				<1.0		<1.0							ng/L	ng/L
METHOXYCHLOR	R				<5.0		<5.0				<5.0		<5.0	5	100000
ng/L	T				<5.0		<5.0				<5.0		<5.0	ng/L	ng/L
MIREX	R				<5.0		<5.0				<5.0		<5.0	5	
ng/L	T				<5.0		<5.0				<5.0		<5.0	ng/L	

MPOS

PLANT Rosehill, Fort Erie WATER QUALITY - 4-YEAR SUMMARY ( )

ORGANOCHLORINES (Cont'd)		1986			* 1985			1984			* 1983			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
OCTACHLOROSTYRENE ng/L	R				<1.0		<1.0							1 ng/L	
	T				<1.0		<1.0								
O,P-DDT ng/L	R				<5.0		<5.0				<5.0		<5.0	5 ng/L	30000 ng/L d
	T				<5.0		<5.0				<5.0		<5.0		
OXYCHLORDANE ng/L	R				<2.0		<2.0				<2.0		<2.0	2 ng/L	
	T				<2.0		<2.0				<2.0		<2.0		
PCB TOTAL ng/L	R				<20.00		<20.00				<20.00		<20.00	20 ng/L	3000 ng/L t
	T				<2.0		<2.0				<2.0		<2.0		
PENTACHLOROBENZENE ng/L	R				<1.0		<1.0							1 ng/L	74000 ng/L e
	T				<1.0		<1.0								
P,P-DDD ng/L	R				<5.0		<5.0				<5.0		<5.0	5 ng/L	d
	T				<5.0		<5.0				<5.0		<5.0		
P,P-DDE ng/L	R				<1.0		<1.0				<1.0		<1.0	1 ng/L	d
	T				<1.0		<1.0				<1.0		<1.0		
P,P-DDT ng/L	R				<5.0		<5.0				<5.0		<5.0	5 ng/L	d
	T				<5.0		<5.0				<5.0		<5.0		
1,2,3,4-TETRACHLOROBENZENE ng/L	R				<1.0		<1.0							1 ng/L	
	T				<1.0		<1.0								
1,2,3,5-TETRACHLOROBENZENE ng/L	R				<1.0		<1.0							1 ng/L	
	T				<1.0		<1.0								

MPOS

PLANT Rosehill, Fort Erie WATER QUALITY - 4-YEAR SUMMARY ( )

ORGANOCHLORINES (Cont'd)		19 86			* 1985			19 84			* 1983			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
1,2,4,5-TETRACHLOROBENZENE	R				<1.0		<1.0							1	38000
ng/L	T				<1.0		<1.0							ng/L	ng/L e
THIODAN I	R				<2.0		<2.0							2	74000
ng/L	T				<2.0		<2.0							ng/L	ng/L ea
THIODAN II	R				<4.0		<4.0							4	74000
ng/L	T				<4.0		<4.0							ng/L	ng/L ea
THIODAN SULPHATE	R				<4.0		<4.0							4	
ng/L	T				<4.0		<4.0							ng/L	
TOXAPHENE	R				-		-								
(no units available)	T				-		-								
1,2,3-TRICHLOROBENZENE	R				<5.0		<5.0							5	10000
ng/L	T				<5.0		<5.0							ng/L	ng/L y
1,2,4-TRICHLOROBENZENE	R				<5.0		<5.0							5	15000
ng/L	T				<5.0		<5.0							ng/L	ng/L y
1,3,5-TRICHLOROBENZENE	R				<5.0		<5.0							5	10000
ng/L	T				<5.0		<5.0							ng/L	ng/L y
2,3,6-TRICHLOROTOLUENE	R				<5.0		<5.0							5	
ng/L	T				<5.0		<5.0							ng/L	
2,4,5-TRICHLOROTOLUENE	R				<5.0		<5.0							5	10000
ng/L	T				<5.0		<5.0							ng/L	ng/L g

MPOS

PLANT Rosehill, Fort Erie WATER QUALITY - 4-YEAR SUMMARY (   )

ORGANOCHLORINES (Cont'd)		19_86			* 19_85			1984			* 19_83			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
2,6,A-TRICHLOROTOLUENE	R				<5.0		<5.0							5	
mg/L	T				<5.0		<5.0							ng/L	
TRIAZINES															
ALACHLOR	R														
ng/L	T														
AMETRINE	R													50	
ng/L	T													ng/L	
ATRATONE	R														
ng/L	T														
ATRAZINE	R													50	46000
ng/L	T													ng/L	ng/L I
BLADEX	R													100	10000
ng/L	T													ng/L	ng/L I
METOLACHLOR	R														
ng/L	T														
PROMETONE	R													50	
ng/L	T													ng/L	
PROMETRYNE	R													50	1000
ng/L	T													ng/L	ng/L I
PROPAZINE	R													50	
ng/L	T													ng/L	

MPOS

PLANT Rosehill, Fort Erie WATER QUALITY - 4-YEAR SUMMARY (   )

TRIAZINES (Cont'd)		19 86			* 19 85			1984			* 1983			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
SENCOR	R													100	
ng/L	T													ng/L	
SIMAZINE	R													50	10000
ng/L	T													ng/L	ng/L 1
SPECIAL PESTICIDES															
2,4-D	R													100	100000
ng/L	T													ng/L	ng/L
2,4-D BUTYRIC ACID	R													200	18000
ng/L	T													ng/L	ng/L 1
DICAMBA	R													100	87000
ng/L	T													ng/L	ng/L 1
PENTACHLOROPHENOL	R													50	10000
ng/L	T													ng/L	ng/L b
PICLORAM	R													100	
ng/L	T													ng/L	
2,4-D PROPIONIC ACID	R													100	
ng/L	T													ng/L	
SILVEX	R													50	10000
ng/L	T													ng/L	ng/L
2,4,5-T	R													50	
ng/L	T													ng/L	

WPOS

PLANT Rosehill, Fort Erie WATER QUALITY - 4-YEAR SUMMARY ( )

SPECIAL PESTICIDES (Cont'd)		19 86			* 1985			19 84			* 19 83			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
2,3,4,5-TETRACHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,3,5,6-TETRACHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,3,4-TRICHLOROPHENOL	R													100	
ng/L	T													ng/L	
2,4,5-TRICHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,4,6-TRICHLOROPHENOL	R													50	10000
ng/L	T													ng/L	ng/L h
ORGANOPHOSPHOROUS PESTICIDES															
DIAZINON	R													50	14000
ng/L	T													ng/L	ng/L
DICHLOROVOS	R														
ng/L	T														
DURSBAN	R														
ng/L	T														
ETHION	R														
ng/L	T														
GUTHION	R														
ng/L	T														

PLANT Rosehill, Fort Erie WATER QUALITY - 4-YEAR SUMMARY ( )

ORGANOPHOSPHOROUS PESTICIDES (Cont'd)		19 86			* 19 85			19 84			* 19 83			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
MALATHION	R														
ng/L	T														
METHYLPARATHION	R													50	7000
ng/L	T													ng/L	ng/L
METHYLTRITHION	R														
ng/L	T														
MEVINPHOS	R														
ng/L	T														
PARATHION	R													50	35000
ng/L	T													ng/L	ng/L
PHORBATE	R														
ng/L	T														
RELDAN	R														
ng/L	T														
RONNEL	R														
ng/L	T														
MASS SPEC.															
DI-N-BUTYL PHTHALATE	R													0.1	34000
ug/L	T													ug/L	ug/L a

MPOS

PLANT Rosehill, Fort Erie WATER QUALITY - 4-YEAR SUMMARY ( ).

MASS SPEC. (Cont'd)		19_86			* 19_85			19_84			* 19_83			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
N-DICHLOROMETHYLENE-PENTACHLOROANALINE ug/L	R													0.1 ug/L	
	T														
DIPHENYL ETHER ug/L	R													0.1 ug/L	
	T														
FLUORANTHENE ug/L	R													0.1 ug/L	
	T														
HEXACHLOROPHOPENE ug/L	R													0.1 ug/L	
	T														
METHYL PHENANTHRENE ug/L	R													0.1 ug/L	
	T														
NAPHTHALENE ug/L	R													0.1 ug/L	
	T														
PENTACHLOROBUTADIENE ug/L	R													0.1 ug/L	
	T														
PENTACHLOROPROPANE ug/L	R													0.1 ug/L	
	T														
PENTACHLOROPROPENE ug/L	R													0.1 ug/L	
	T														
PYRENE ug/L	R													0.1 ug/L	
	T														

MASS SPEC. (Cont'd)		1986			* 19 85			1984			* 19 83			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
TETRACHLORBUTANE ug/L	R T													0.1 ug/L	
TETRACHLORODIPHENYL ug/L	R T													0.1 ug/L	
BACTERIA															
RAW WATER:															
TOTAL COLIFORM MF count/100mL	R														
TOTAL COLIFORM BKGD count/100mL	R	3072	14	326	441	16	159								
FECAL COLIFORM MF count/100mL	R	43	2	11	87	2	19.6							0	0/0.1 mL
STANDARD PLATE COUNT MF count/100mL	R													0	500
TREATED WATER:															
PRESENT/ABSENT TEST	T														
TOTAL COLIFORM BACKGROUND MF count/100mL	T													0	OWDO Bact1

MPOS

PLANT Rosehill, Fort Erie WATER QUALITY - 4-YEAR SUMMARY (   )

BACTERIA (Cont'd)		1986			* 19 85			1984			* 1983			DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE	MAX	MIN	AVE		
TREATED WATER: (Cont'd)															
FECAL COLIFORM MF count/100mL	T													0	ODWO Bact I
STANDARD PLATE COUNT MF count/100mL	T														
IF PRESENT/ABSENT TEST POSITIVE:															
COLIFORM P/A	T														
FECAL COLIFORM P/A	T														
E. COLI P/A	T														
AROMONAS P/A	T														
STAPH. AUREUS P/A	T														

Table 4.10

PLANT Rosehill WTP

MOS
WATER QUALITY - 1-YEAR SUMMARY (   )

GENERAL CHEMISTRY		19 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	OWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
GENERAL CHEMISTRY															
ALKALINITY	R													0.2	
mg/L	T													mg/L	
AMMONIUM TOTAL	R													0.05	
mg/L	T	.015	.008	.016	.018	.034	.026	.041	.035	.036	.031	.013	.007	mg/L	
CALCIUM	R													0.1	
mg/L	T													mg/L	
CHLORIDE	R													0.2	250
mg/L	T	16.14	15.27	15.9	14.89	16.05	16.10	15.68	15.50	15,80	15.86	15.83	16.20	mg/L	mg/L
COLOUR TCU	R													0.5	5
	T													TCU	TCU
CONDUCTIVITY	R													0.01	
umho/cm	T	304.2	301.3	293.0	274.3	288.0	287.5	281.0	279.0	282.0	291.0	295.0	213.0	UMHO/CM	
FIELD CHLORINE (COMBINED)	R													0.1	
mg/L	T													mg/L	
FIELD CHLORINE (FREE)	R													0.1	
mg/L	T													mg/L	
FIELD CHLORINE (TOTAL)	R													0.1	
mg/L	T													mg/L	
FIELD PH	R													0.2	
	T														

Table 4.10

PLANT Rosehill WTP

MOS
WATER QUALITY - 1-YEAR SUMMARY ( )

GENERAL CHEMISTRY (Cont'd)		1986 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	OWSP DETECTION LIMIT*	DRINKING WATER OBJ/GUIDELINE[1]
FIELD TEMPERATURE	R														
°C	T														
FIELD TURBIDITY	R														1 FTU
FTU	T														
FLUORIDE	R													0.01	2.4
mg/L	T													mg/L	mg/L
HARDNESS	R													0.5	
mg/L	T													mg/L	
MAGNESIUM	R													0.05	
mg/L	T													mg/L	c
NITRATE	R													0.05	10 mg/L
mg/L	T	.38	.36	.32	.29	.31	.26	.19	.20	.14	.20	.22	.30	mg/L	as N
NITRITE	R													0.005	1 mg/L
mg/L	T													mg/L	as N
NITROGEN TOTAL KJELDAHL	R													0.1	0.15
mg/L	T	0.23	0.21	0.23	0.24	0.31	0.32	0.27	0.25	0.29	0.32	0.26	0.24	mg/L	mg/L *
PH	R														
	T														
PHOSPHORUS FILTERED REACTIVE	R													0.01	
mg/L	T	0.013	0.008	0.003	0.002	0.002	0.004	0.003	0.00	0.002	0.002	0.00	0.00	mg/L	

Table 4.10

PLANT Rosehill WTP

MOS
WATER QUALITY - 1-YEAR SUMMARY (   )

GENERAL CHEMISTRY (Cont'd)		1986 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
PHOSPHORUS TOTAL	R													0.01	
mg/L	T	.025	.016	.014	.014	.017	.029	.013	.014	.016	.018	.022	.022	mg/L	
SODIUM	R													0.1	
mg/L	T													mg/L	
TOTAL SOLIDS	R													1	
mg/L	T													mg/L	
TURBIDITY	R													0.01	1
FTU	T													FTU	FTU
METALS															
ALUMINUM	R													0.003	
mg/L	T													mg/L	
ARSENIC	R													0.001	0.05
mg/L	T													mg/L	mg/L
BARIUM	R													0.001	1
mg/L	T													mg/L	mg/L
BERYLLIUM	R													0.001	
mg/L	T													mg/L	
BORON	R													0.02	5
mg/L	T													mg/L	mg/L
CADMIUM	R													0.0003	0.005
mg/L	T													mg/L	mg/L

Table 4.10

MPOS

PLANT Rsehill WTP WATER QUALITY - 1-YEAR SUMMARY ( )

METALS (Cont'd)			19 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
CHROMIUM		R													0.001	0.05
	mg/L	T													mg/L	mg/L
COBALT		R													0.001	
	mg/L	T													mg/L	
COPPER		R													0.001	1
	mg/L	T													mg/L	mg/L
CYANIDE		R													0.001	0.2
	mg/L	T													mg/L	mg/L
IRON		R													0.002	0.3
	mg/L	T													mg/L	mg/L
LEAD	mg/L	R													0.003	0.05
		T													mg/L	mg/L
MANGANESE		R													0.001	0.05
	mg/L	T													mg/L	mg/L
MOLYBDENUM		R													0.001	
	mg/L	T													mg/L	
MERCURY		R													0.01	1
	ug/L	T													ug/L	ug/L
NICKEL		R													0.002	
	mg/L	T													mg/L	

Table 4.10

MPOS

PLANT Rosehill WTP WATER QUALITY - 1-YEAR SUMMARY ( )

METALS (Cont'd)		19 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
SELENIUM	R													0.001	0.01
mg/L	T													mg/L	mg/L
STRONTIUM	R													0.001	
mg/L	T													mg/L	
TIN	R														
(no units available)	T														
URANIUM	R													0.002	.02
mg/L	T													mg/L	mg/L t
VANADIUM	R													0.001	
mg/L	T													mg/L	
ZINC	R													0.001	5
mg/L	T													mg/L	mg/L h
PURGEABLES															
BENZENE	R													1	10
ug/L	T													ug/L	ug/L h
BROMOFORM	R													1	350
ug/L	T													ug/L	ug/L **
CARBON TETRACHLORIDE	R													1	3
ug/L	T													ug/L	ug/L h
CHLOROBENZENE	R													1	100-300
ug/L	T													ng/L	ng/L h*

Table 4.10

MPOS

PLANT Rosehill WTP WATER QUALITY - 1-YEAR SUMMARY ( )

PURGEABLES (Cont'd)		19 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
CHLORODIBROMOMETHANE	R													1	350
ug/L	T													ug/L	ug/L ++
CHLOROFORM	R													1	350
ug/L	T													ug/L	ug/L ++
1,2-DICHLOROBENZENE	R													1	400
ug/L	T													ug/L	ug/L •
1,3-DICHLOROBENZENE	R													1	400
ug/L	T													ug/L	ug/L •
1,4-DICHLOROBENZENE	R													1	400
ug/L	T													ug/L	ug/L •
DICHLOROBROMOMETHANE	R													1	350
ug/L	T													ug/L	ug/L ++
1,1-DICHLOROETHANE	R													1	
ug/L	T													ug/L	
1,2-DICHLOROETHANE	R													1	10
ug/L	T													ug/L	ug/L h
1,1-DICHLOROETHYLENE	R													1	.3
ug/L	T													ug/L	ug/L h
T,1,2-DICHLOROETHYLENE	R													1	
ug/L	T													ug/L	

Table 4.10

WPOS

PLANT Rosehill WTP WATER QUALITY - 1-YEAR SUMMARY ( )

PURGEABLES (Cont'd)		1986 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
DICHLOROMETHANE	R													5	40
ug/L	T													ug/L	ug/L c
1,2 DICHLOROPROPANE	R													1	
ug/L	T													ug/L	
ETHYLBENZENE	R													1	1400
ug/L	T													ug/L	ug/L e
ETHYLENE DIBROMIDE	R														
ug/L	T														
M-XYLENE	R													1	620
ug/L	T													ug/L	ug/L c
O-XYLENE	R													1 ug/L	620
ug/L	T														ug/L c
P-XYLENE	R													1	620
ug/L	T													ug/L	ug/L c
TOLUENE	R													1	100
ug/L	T													ug/L	ug/L c
1,1,2,2-TETRACHLOROETHANE	R													1	1.7
ug/L	T													ug/L	ug/L e
TETRACHLOROETHYLENE	R													1	10
ug/L	T													ug/L	ug/L h

Table 4.10

MPOS

PLANT Rosehill WTP WATER QUALITY - 1-YEAR SUMMARY ( )

PURGEABLES (Cont'd)		19 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
1,1,1-TRICHLOROETHANE	R													1	1000
ug/L	T													ug/L	ug/L c
1,1,2-TRICHLOROETHANE	R													1	6
ug/L	T													ug/L	ug/L e
TRICHLOROETHYLENE	R													1	30
ug/L	T													ug/L	ug/L h
TOTAL TRIHALOMETHANES	R													3	350
ug/L	T													ug/L	ug/L ++
TRIFLUOROCHLOROTOLUENE	R													1	
ug/L	T													ug/L	
ORGANOCHLORINES															
ALDRIN	R													1	700
ng/L	T													ng/L	ng/L **
ALPHA BHC	R													1	700
ng/L	T													ng/L	ng/L c
ALPHA CHLORDANE	R													2	700
ng/L	T													ng/L	ng/L ***
BETA BHC	R													1	300
ng/L	T													ng/L	ng/L c
DIELDRIN	R													2	700
ng/L	T													ng/L	ng/L **

Table 4.10

MPOS

PLANT Rosehill WTP WATER QUALITY - 1-YEAR SUMMARY ( )

ORGANOCHLORINES (Cont'd)		19 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT[a]	DRINKING WATER OBJ/ GUIDELINE[1]
ENDRIN	R													4	200
ng/L	T													ng/L	ng/L
GAMMA CHLORDANE	R													2	700
ng/L	T													ng/L	ng/L ***
HEPTACHLOR EPOXIDE	R													1	3000 ***
ng/L	T													ng/L	ng/L
HEPTACHLOR	R													1	3000
ng/L	T													ng/L	ng/L ***
HEXACHLOROBENZENE	R													1	10
ng/L	T													ng/L	ng/L h
HEXACHLOROBUTADIENE	R														
ug/L	T														
HEXACHLOROETHANE	R													1	19000
ng/L	T													ng/L	ng/L *
LINDANE	R													1	4000
ng/L	T													ng/L	ng/L
METHOXYCHLOR	R													5	100000
ng/L	T													ng/L	ng/L
MIREX	R													5	
ng/L	T													ng/L	

Table 4.10

MPOS

PLANT Rosehill WTP WATER QUALITY - 1-YEAR SUMMARY ( )

ORGANOCHLORINES (Cont'd)		19 86												DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
OCTACHLOROSTYRENE ng/L	R													1	
	T													ng/L	
O,P-DDT ng/L	R													5	30000
	T													ng/L	ng/L d
OXYCHLORDANE ng/L	R													2	
	T													ng/L	
PCB TOTAL ng/L	R													20	3000
	T													ng/L	ng/L t
PENTACHLOROBENZENE ng/L	R													1	74000
	T													ng/L	ng/L e
P,P-DDD ng/L	R													5	d
	T													ng/L	
P,P-DDE ng/L	R													1	d
	T													ng/L	
P,P-DDT ng/L	R													5	d
	T													ng/L	
1,2,3,4-TETRACHLOROBENZENE ng/L	R													1	
	T													ng/L	
1,2,3,5-TETRACHLOROBENZENE ng/L	R													1	
	T													ng/L	

Table 4.10

MPOS

PLANT Rosehill WTP WATER QUALITY - 1-YEAR SUMMARY ( )

ORGANOCHLORINES (Cont'd)		1 9 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
1,2,4,5-TETRACHLOROBENZENE	R													1	38000
ng/L	T													ng/L	ng/L *
THIODAN I	R													2	74000
ng/L	T													ng/L	ng/L **
THIODAN II	R													4	74000
ng/L	T													ng/L	ng/L **
THIODAN SULPHATE	R													4	
ng/L	T													ng/L	
TOXAPHENE	R														
(no units available)	T														
1,2,3-TRICHLOROBENZENE	R													5	10000
ng/L	T													ng/L	ng/L y
1,2,4-TRICHLOROBENZENE	R													5	15000
ng/L	T													ng/L	ng/L y
1,3,5-TRICHLOROBENZENE	R													5	10000
ng/L	T													ng/L	ng/L y
2,3,6-TRICHLOROTOLUENE	R													5	
ng/L	T													ng/L	
2,4,5-TRICHLOROTOLUENE	R													5	10000
ng/L	T													ng/L	ng/L g

Table 4.10

MPOS

PLANT Rosehill WTP WATER QUALITY - 1-YEAR SUMMARY ( )

ORGANOCHLORINES (Cont'd)		1 9 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
2,6,A-TRICHLOROTOLUENE	R													5	
mg/L	T													ng/L	
TRIAZINES															
ALACHLOR	R														
ng/L	T														
AMETRINE	R													50	
ng/L	T													ng/L	
ATRATONE	R														
ng/L	T														
ATRAZINE	R													50	46000
ng/L	T													ng/L	ng/L 1
BLADEX	R													100	10000
ng/L	T													ng/L	ng/L 1
METOLACHLOR	R														
ng/L	T														
PROMETONE	R													50	
ng/L	T													ng/L	
PROMETRYNE	R													50	1000
ng/L	T													ng/L	ng/L 1
PROPAZINE	R													50	
ng/L	T													ng/L	

Table 4.10

MPOS

PLANT Rosehill WTP WATER QUALITY - 1-YEAR SUMMARY ( )

TRIAZINES (Cont'd)		1 9 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
SENCOR	R													100	
ng/L	T													ng/L	
SIMAZINE	R													50	10000
ng/L	T													ng/L	ng/L
SPECIAL PESTICIDES															
2,4-D	R													100	100000
ng/L	T													ng/L	ng/L
2,4-D BUTYRIC ACID	R													200	18000
ng/L	T													ng/L	ng/L
DICAMBA	R													100	87000
ng/L	T													ng/L	ng/L
PENTACHLOROPHENOL	R													50	10000
ng/L	T													ng/L	ng/L
PICLORAM	R													100	
ng/L	T													ng/L	
2,4-D PROPIONIC ACID	R													100	
ng/L	T													ng/L	
SILVEX	R													50	10000
ng/L	T													ng/L	ng/L
2,4,5-T	R													50	
ng/L	T													ng/L	

Table 4.10

PLANT Rosehill WTP

MPOS
WATER QUALITY - 1-YEAR SUMMARY ( )

SPECIAL PESTICIDES (Cont'd)		1986 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE¹
2,3,4,5-TETRACHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,3,5,6-TETRACHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,3,4-TRICHLOROPHENOL	R													100	
ng/L	T													ng/L	
2,4,5-TRICHLOROPHENOL	R													50	
ng/L	T													ng/L	
2,4,6-TRICHLOROPHENOL	R													50	10000
ng/L	T													ng/L	ng/L h
ORGANOPHOSPHOROUS PESTICIDES															
DIAZINON	R													50	14000
ng/L	T													ng/L	ng/L
DICHLOROVOS	R														
ng/L	T														
DURSBAN	R														
ng/L	T														
ETHION	R														
ng/L	T														
GUTHION	R														
ng/L	T														

Table 4.10

MPOS

PLANT Rosehill WTP WATER QUALITY - 1-YEAR SUMMARY ( )

ORGANOPHOSPHOROUS PESTICIDES (Cont'd)		1 9 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT[a]	DRINKING WATER OBJ/ GUIDELINE[1]
MALATHION	R														
ng/L	T														
METHYLPARATHION	R													50	7000
ng/L	T													ng/L	ng/L
METHYLTRITHION	R														
ng/L	T														
MEVINPHOS	R														
ng/L	T														
PARATHION	R													50	35000
ng/L	T													ng/L	ng/L
PHORBATE	R														
ng/L	T														
RELDAN	R														
ng/L	T														
RONNEL	R														
ng/L	T														
MASS SPEC.															
DI-N-BUTYL PHTHALATE	R													0.1	34000
ug/L	T													ug/L	ug/L

Table 4.10

MPOS

PLANT Rosehill WTP WATER QUALITY - 1-YEAR SUMMARY ( )

MASS SPEC. (Cont'd)		19 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
N-DICHLOROMETHYLENE-PENTACHLOROANALINE	R													0.1	
ug/L	T													ug/L	
DIPHENYL ETHER	R													0.1	
ug/L	T													ug/L	
FLUORANTHENE	R													0.1	
ug/L	T													ug/L	
HEXACHLOROPROPENE	R													0.1	
ug/L	T													ug/L	
METHYL PHENANTHRENE	R													0.1	
ug/L	T													ug/L	
NAPHTHALENE	R													0.1	
ug/L	T													ug/L	
PENTACHLOROBUTADIENE	R													0.1	
ug/L	T													ug/L	
PENTACHLOROPROPANE	R													0.1	
ug/L	T													ug/L	
PENTACHLOROPROPENE	R													0.1	
ug/L	T													ug/L	
PYRENE	R													0.1	
ug/L	T													ug/L	

Table 4.10

MPOS

PLANT Rosehill WTP WATER QUALITY - 1-YEAR SUMMARY ( )

MASS SPEC. (Cont'd)		19 86 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
TETRACHLORBUTANE ug/L	R T													0.1 ug/L	
TETRACHLOROBIPHENYL ug/L	R T													0.1 ug/L	
BACTERIA															
RAW WATER:															
TOTAL COLIFORM MF count/100mL	R														
TOTAL COLIFORM BKGD count/mL	R	121	3072	71	26	90	14	56	21	–	334	40	72		
FECAL COLIFORM MF count/100mL	R	11	43	7	2	24	2	2	3	2	19	3	15	0	0/0.1 mL
STANDARD PLATE COUNT MF count/100mL	R													0	500
TREATED WATER:															
PRESENT/ABSENT TEST	T														
TOTAL COLIFORM BACKGROUND MF count/100mL	T													0	DWOO Bact I

Table 4.10

WPOS

PLANT Rosehill WTP WATER QUALITY - 1-YEAR SUMMARY ( )

BACTERIA (Cont'd)		1 9 86												DWSP DETECTION LIMIT*	DRINKING WATER OBJ/ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC		
TREATED WATER: (Cont'd)															
FECAL COLIFORM MF count/100mL	T													0	ODWO Bact I
STANDARD PLATE COUNT MF count/100mL	T														
IF PRESENT/ABSENT TEST POSITIVE:															
COLIFORM P/A	T														
FECAL COLIFORM P/A	T														
E. COLI P/A	T														
AROMONAS P/A	T														
STAPH. AUREUS P/A	T														

Table A - Footnotes

1 = see individual footnotes for Agency of guideline origin

c = California State Department of Health Action Level

d = OWDO for DDT (contains other isomers such as OPDDT and PPDDT)

e = USEPA ambient guideline

ee = United States Environmental Protection Agency (USEPA) ambient level for endosulfan (contains other isomers)

ep = USEPA proposed maximum contaminant level for drinking water

g = suggested Health and Welfare Canada/Ontario Ministry of the Environment guideline value

h = World Health Organization (WHO) guideline

h* = World Health Organization (WHO) Odour Threshold

mg/L = milligrams per litre, parts per million, (ppm)

ng/L = nanograms per litre, parts per trillion, (ppt)

Presence/Absence = microbiological test to indicate presence or absence of coliform bacteria

R = raw water

T = Treated Drinking Water

t = ODWO interim maximum acceptable concentration, (IMAC)

ug/L = micrograms per litre, parts per billion, (ppb)

y = New York State (Taste and Odour) proposed drinking water guideline

++ = total Trihalomethanes

+++ = combined total: Heptachlor and Heptachlor Epoxide

* = if other than DWSP Detection Limit

** = total of Aldrin and Dieldrin

*** = Chlordane is a mixture of alpha and gamma isomers

I = Ministry of the Environment and Health and Welfare Canada, (IMAC)

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE 1986 CARBON DOSAGES

MOE WPOS PROTOCOL

DATE	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
1							0.73	1.52	1.31			
2							1.18	1.35	1.31			
3							1.14	1.57	1.63			
4							0.85	2.25	*			
5							1.57	1.64				
6							1.62	1.45				
7							2.38	1.74				
8							0.77	1.57				
9							1.29	1.82				
10							1.75	1.36				
11							1.49	1.29				
12							1.36	0.00				
13							1.28	1.49				
14							1.63	1.96				
15							1.20	1.67				

TABLE 4.1 (cont'd)

DATE	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
16							1.34	1.21				
17							1.36	1.35				
18							0.93	1.53				
19							1.65	2.02				
20							1.38	1.46				
21							1.66	1.29				
22							1.26	1.37				
23							1.64	1.66				
24							1.66	1.77				
25							1.59	1.74				
26							1.03	1.55				
27						1.65	1.36	3.02				
28						1.73	1.38	1.55				
29							1.17	1.60				
30						3.68	1.52	1.93				
31							1.17	1.50				

* FLUSHING CARBON SYSTEM WITH WATER

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE
1985 CARBON DOSAGES

MOE WPOS PROTOCOL

DATE	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
1							2.45	3.90				
2							2.70	7.12				
3							3.69	4.08				
4							3.93	3.77				
5							2.46	4.08				
6							4.36	2.24				
7							2.87	6.01				
8							2.36	2.90				
9							4.20	6.96				
10							2.42	2.79				
11							3.23	4.31				
12							3.57	3.69				
13							3.26	4.36				
14							2.01	3.18				
15							4.46	5.57				

TABLE 4.1 (cont'd)

DATE	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
16							2.97	2.65				
17							2.67	3.38				
18							3.57	3.31				
19							4.53	3.72				
20							3.09	3.32				
21							4.60	3.50				
22							5.72	3.05				
23							2.31	3.04				
24							10.93	4.61				
25							6.91	2.70				
26							6.37	6.05				
27							5.17	4.91				
28						2.96	5.13	5.43				
29						3.30	2.39	4.98				
30						3.15	3.43	3.19				
31							8.55					

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE
1984 CARBON DOSAGES

MOE WPOS PROTOCOL

DATE	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
1									1.39			
2									1.73			
3									1.75			
4									2.30			
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												

DATE	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28						3.89	6.89					
29							5.82					
30							5.59					
31												

TABLE 4.1: T&O CONTROL, ALKALINITY ADJ. & FLUORIDATION PROFILE
1983 CARBON DOSAGES

MOE WPOS PROTOCOL

DATE	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
1												
2												
3												
4												
5								5.34				
6								3.79				
7												
8												
9												
10												
11												
12												
13												
14												
15								4.83				

TABLE 4.1 (cont'd)

DATE	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
16								2.51				
17								2.50				
18								4.47				
19								2.45				
20								1.73				
21								3.59				
22								2.76				
23												
24												
25												
26												
27												
28												
29												
30												
31												

TABLE 5
WATER PLANT OPTIMIZATION STUDY
"PARTICULATE COUNTING, SUSPENDED SOLIDS AND ALGAE COUNTS"

TABLE 5.0: ALGAE COUNT

* No data available to complete table

MONTH	COUNT				
JAN	Max. Min. Avg. No. Tests				
FEB	Max. Min. Avg. No. Tests				
MAR	Max. Min. Avg. No. Tests				
APR	Max. Min. Avg. No. Tests				
MAY	Max. Min. Avg. No. Tests				
JUN	Max. Min. Avg. No. Tests				

TABLE 5.0 (cont'd.)

MONTH	COUNT				
JUL	Max. Min. Avg. No. Tests				
AUG	Max. Min. Avg. No. Tests				
SEP	Max. Min. Avg. No. Tests				
OCT	Max. Min. Avg. No. Tests				
NOV	Max. Min. Avg. No. Tests				
DEC	Max. Min. Avg. No. Tests				

TABLE 6
WATER PLANT OPTIMIZATION STUDY
"BACTERIOLOGICAL TESTING"

TABLE 6.0:BACTERIOLOGICAL TESTING (1986) ROSEHILL WTP

MOE WPOS PROTOCOL

		TOTAL COLIFORM					FECAL COLIFORM					FECAL STREPTOCOCCUS			
		Absent	1-5	6-100	101-5000	>5000	Absent	1-5	6-10	11-500	>500	Absent	1	2-50	>50
JAN	R	-	-	2	1	-	-	1	-	2	-	-	-	3	-
	T	3	-	-	-	-	3	-	-	-	-	3	-	-	-
FEB	R	-	-	-	2	1	-	-	-	3	-	-	-	3	-
	T	3	-	-	-	-	3	-	-	-	-	3	-	-	-
MAR	R	-	-	2	1	-	-	2	-	1	-	-	-	3	-
	T	3	-	-	-	-	3	-	-	-	-	3	-	-	-
APR	R	-	4	-	1	-	-	3	-	-	-	-	-	3	-
	T	3	-	-	-	-	3	-	-	-	-	3	-	-	-
MAY	R	-	-	2.	1	-	-	1	-	2	-	-	-	2	1
	T	3	-	-	-	-	3	-	-	-	-	3	-	-	-
JUN	R	-	1	3	-	-	-	1	3	-	-	-	-	3	-
	T	3	-	-	-	-	3	-	-	-	-	3	-	-	-
JUL	R	-	2	2	-	-	-	4	-	-	-	-	-	4	-
	T	3	-	-	-	-	3	-	-	-	-	3	-	-	-
AUG	R	-	2	1	1	-	-	4	-	-	-	-	-	4	-
	T	3	-	-	-	-	3	-	-	-	-	3	-	-	-
SEP	R	-	1	1	-	-	-	2	-	-	-	-	-	2	-
	T	4	-	-	-	-	4	-	-	-	-	4	-	-	-
OCT	R	-	-	2	2	-	-	1	2	1	-	-	-	4	-
	T	4	-	-	-	-	4	-	-	-	-	4	-	-	-
NOV	R	-	-	3	-	-	-	2	1	-	-	-	-	3	-
	T	2	-	-	-	-	2	-	-	-	-	2	-	-	-
DEC	R	-	-	2	1	-	-	-	1	2	-	-	-	3	-
	T	3	-	-	-	-	3	-	-	-	-	3	-	-	-

NOTE: All results are for 100 mL samples; tests carried out at MOE lab

R = Raw; T = Treated

TABLE 6.1: BACTERIOGICAL TESTING (1985) ROSEHILL WTP

MOE WPOS PROTOCOL

		TOTAL COLIFORM					FECAL COLIFORM					FECAL STREPTOCOCCUS			
		Absent	1-5	6-100	101-5000	>5000	Absent	1-5	6-10	11-500	>500	Absent	1	2-50	>50
JAN	R	-	-	2	3	-	-	2	-	3	-	-	-	3	2
	T	5	-	-	-	-	5	-	-	-	-	5	-	-	-
FEB	R	-	-	3	-	-	-	2	-	1	-	-	-	3	-
	T	3	-	-	-	-	3	-	-	-	-	3	-	-	-
MAR	R	-	-	1	3	-	-	-	1	3	-	-	-	4	-
	T	4	-	-	-	-	4	-	-	-	-	4	-	-	-
APR	R	-	2	2	-	-	-	4	-	-	-	-	-	4	-
	T	4	-	-	-	-	4	-	-	-	-	4	-	-	-
MAY	R	-	1	-	2	-	-	2	1	-	-	-	-	3	-
	T	3	-	-	-	-	3	-	-	-	-	3	-	-	-
JUN	R	-	1	2	-	-	-	3	-	-	-	-	-	3	-
	T	3	-	-	-	-	3	-	-	-	-	3	-	-	-
JUL	R	-	-	1	4	-	-	5	-	-	-	-	-	5	-
	T	5	-	-	-	-	5	-	-	-	-	5	-	-	-
AUG	R	-	1	-	1	-	-	2	-	-	-	-	-	2	-
	T	3	-	-	-	-	3	-	-	-	-	3	-	-	-
SEP	R	-	3	1	-	-	-	3	1	-	-	-	-	4	-
	T	4	-	-	-	-	4	-	-	-	-	4	-	-	-
OCT	R	-	1	5	-	-	-	4	2	-	-	-	-	6	-
	T	5	-	-	-	-	5	-	-	-	-	5	-	-	-
NOV	R	-	-	1	3	-	-	-	1	3	-	-	-	4	-
	T	4	-	-	-	-	4	-	-	-	-	4	-	-	-
DEC	R	-	-	1	3	-	-	-	1	3	-	-	-	3	1
	T	4	-	-	-	-	4	-	-	-	-	4	-	-	-

NOTE: All results are for 100 ml samples. Tests are carried out at MOE lab, Resources Road

R = RAW , T = TREATED

TABLE 6.2: BACTERIOLOGICAL TESTING (1984) ROSEHILL WTP

MOE WPOS PROTOCOL

		TOTAL COLIFORM					FECAL COLIFORM					FECAL STREPTOCOCCUS			
		Absent	1-5	6-100	101-5000	>5000	Absent	1-5	6-10	11-500	>500	Absent	1	2-50	>50
JAN	R	-	-	4	1	-	-	3	1	1	-	-	-	5	-
	T	5	-	-	-	-	5	-	-	-	-	5	-	-	-
FEB	R	-	-	4	-	-	-	2	2	-	-	-	-	4	-
	T	4	-	-	-	-	4	-	-	-	-	4	-	-	-
MAR	R	-	-	3	1	-	-	3	1	-	-	-	-	4	-
	T	4	-	-	-	-	4	-	-	-	-	4	-	-	-
APR	R	-	4	-	-	-	-	4	-	-	-	-	-	4	-
	T	4	-	-	-	-	4	-	-	-	-	4	-	-	-
MAY	R	-	2	2	1	-	-	3	2	-	-	-	-	5	-
	T	5	-	-	-	-	5	-	-	-	-	5	-	-	-
JUN	R	-	1	2	1	-	-	3	1	-	-	-	-	4	-
	T	4	-	-	-	-	4	-	-	-	-	4	-	-	-
JUL	R	-	-	5	-	-	-	5	-	-	-	-	-	5	-
	T	5	-	-	-	-	5	-	-	-	-	5	-	-	-
AUG	R	-	-	3	1	-	-	2	2	-	-	-	-	4	-
	T	4	-	-	-	-	4	-	-	-	-	4	-	-	-
SEP	R	-	-	3	-	-	-	2	1	-	-	-	-	3	-
	T	3	-	-	-	-	3	-	-	-	-	3	-	-	-
OCT	R	-	2	3	-	-	-	5	-	-	-	-	-	5	-
	T	5	-	-	-	-	5	-	-	-	-	5	-	-	-
NOV	R	-	-	1	3	-	-	1	-	3	-	-	-	4	-
	T	4	-	-	-	-	4	-	-	-	-	4	-	-	-
DEC	R	-	-	1	2	-	-	1	-	2	-	-	-	3	-
	T	3	-	-	-	-	3	-	-	-	-	3	-	-	-

NOTE: All results are for 100 mL samples; tests carried out at MOE lab

R = Raw; T = Treated

TABLE 6.1 : BACTERIOLOGICAL TESTING (ROSEHILL,F.ERIE)

MOE WPOS PROTOCOL

		1986		1985		1984		1983	
		FECAL COLI	TOTAL COLI	FECAL COLI	TOTAL COLI	FECAL COLI	TOTAL COLI	FECAL COLI	TOTAL COLI
JAN	R	11	121	61	441	6	38	25	94
	T	0	0	0	0	0	0	0	0
FEB	R	43	3,072	7	44	5	28	2	9
	T	0	0	0	0	0	0	0	0
MAR	R	7	71	16	318	7	68	2	20
	T	0	0	0	0	0	0	0	0
APR	R	2	26	3	27	2	2	2	74
	T	0	0	0	0	0	0	0	0
MAY	R	24	90	4	262	4	30	2	12
	T	0	0	0	0	0	0	0	0
JUN	R	2	14	3	24	5	153	2	75
	T	0	0	0	0	0	0	0	0
JUL	R	2	56	2	155	2	25	2	26
	T	0	0	0	0	0	0	0	0
AUG	R	3	21	2	251	6	106	3	55
	T	0	0	0	0	0	0	0	0
SEP	R	2	-	4	52	5	47	3	157
	T	0	0	0	0	0	0	0	0
OCT	R	19	334	4	16	2	10	6	240
	T	0	0	0	0	0	0	0	0
NOV	R	3	40	87	-	43	342	6	59
	T	0	0	0	0	0	0	0	0
DEC	R	15	72	42	-	29	267	19	168
	T	0	0	0	0	0	0	0	0

NOT 1. Indicator bacteria per 100 mL of sample
2. R = Raw; T = Treated
3. Determine frequency with which tests are done
4. Compare lab and outside data if possible
5. Inbdicate frquency of testing; record monthly average

TABLE 7
WATER PLANT OPTIMIZATION STUDY
"ONTARIO DRINKING WATER OBJECTIVES
EXCEEDANCE SUMMARY

TABLE 7.0: ONTARIO DRINKING WATER OBJECTIVES INCLUDING ALUMINUM (TREATED WATER AT PLANT)

DATE	PARAMETER	MEASURED PARAMETER	OBJECTIVE LIMIT
Jan. 4/86	Turbidity	1.2 NTU	1.0 NTU
Jan. 5/86	"	1.26	"
Jan. 25/86	"	1.30	"
Jan.26/86	"	1.50	"
Feb. 19/86	"	1.12	"
Mar. 16/86	"	1.16	"
Mar. 11/85	Turbidity	1.21 NTU	1.0 NTU
Mar. 12/85	"	1.13	"
Nov. 5/85	"	1.10	"
Nov. 6/85	"	3.25 *	"
Nov. 7/85	"	1.03	"
Feb. 24/84	Turbidity	1.62 NTU	1.0 NTU
Feb. 25/84	"	1.30	"
Mar. 31/84	"	1.22	"

* As per monthly performance reports

APPENDIX B - DAILY LOG SHEET

THE REGIONAL MUNICIPALITY OF NIAGARA
DAILY RECORD
ROSEHILL WATER PLANT

DATE

TIME	CHLORINE					
	SCALE		TOTAL ACTUAL	DOSAGE IN mg/L		
	READING	USED kg		PRE	SET POST	POST T
0000						
0800						
1600						
2400						
	TOTAL					

SHIFT	SENIOR OPERATOR
0000	
0800	
0800	
1600	
1600	
2400	

FLOW SUMMARY		RAW WATER	TREATED WATER
MINIMUM RATE	m³/d	TIME	TIME
MAXIMUM RATE	m³/d	TIME	TIME
TOTAL	m³		

TIME	ALUM					
	STORAGE TANKS			DOSAGE IN mg/L		
	No 1 READING IN L	No 2 READING IN L	USED LITRES	WEST SET	EAST SET	PLANT TOTAL ACTUAL
0000						
0800						
1600						
2400						
		TOTAL				

TIME	FLOW METERS					
	RAW WATER		RECYCLED WATER		TREATED WATER	
	READING ×10 = m³	USED m³	READING m³	USED m³	READING ×10 = m³	USED m³
0000						
0800						
1600						
2400						
			TOTAL			

TIME	POWDERED ACTIVATED CARBON			
	STOCK kg	USED kg	DOSAGE ACTUAL mg/L	SET mg/L
0000				
0800				
1600				
2400				
	TOTAL			

SLUDGE						
RECYCLE TIME			RECIRCULATE TIME			
ON/OFF /			ON/OFF/AUTO / /			
ON/OFF /			ON/OFF/AUTO / /			
ON/OFF /			ON/OFF/AUTO / /			
HAULAGE						
LOAD	1	2	3	4	5	6
VOLUME m³						
% TOT SOLIDS						

TIME	CHLORINE RESIDUAL IN mg/L						TURBIDITY IN NTU					
	PRE FREE	POST FREE	POST TOUCH UP FREE	COMB	TOTAL	%	RAW WATER	SETTLED WEST	SETTLED EAST	FILTER No	FILTER EFFL	FINISHED WATER
0000												
0400												
0800												
1200												
1600												
2000												

FILTER BACKWASH											
TIME O/S	FILTER NO	END OF RUN			WASH WATER			RATE			
		HEAD LOSS	EFFL TURB	DURATION	READING		USED	LOW		HIGH	
		METRE	NTU	HOURS	STOP ×10m³	START ×10m³	m³	LITRES SEC	MINUTES	LITRES/SEC	MINUTES
						TOTAL					

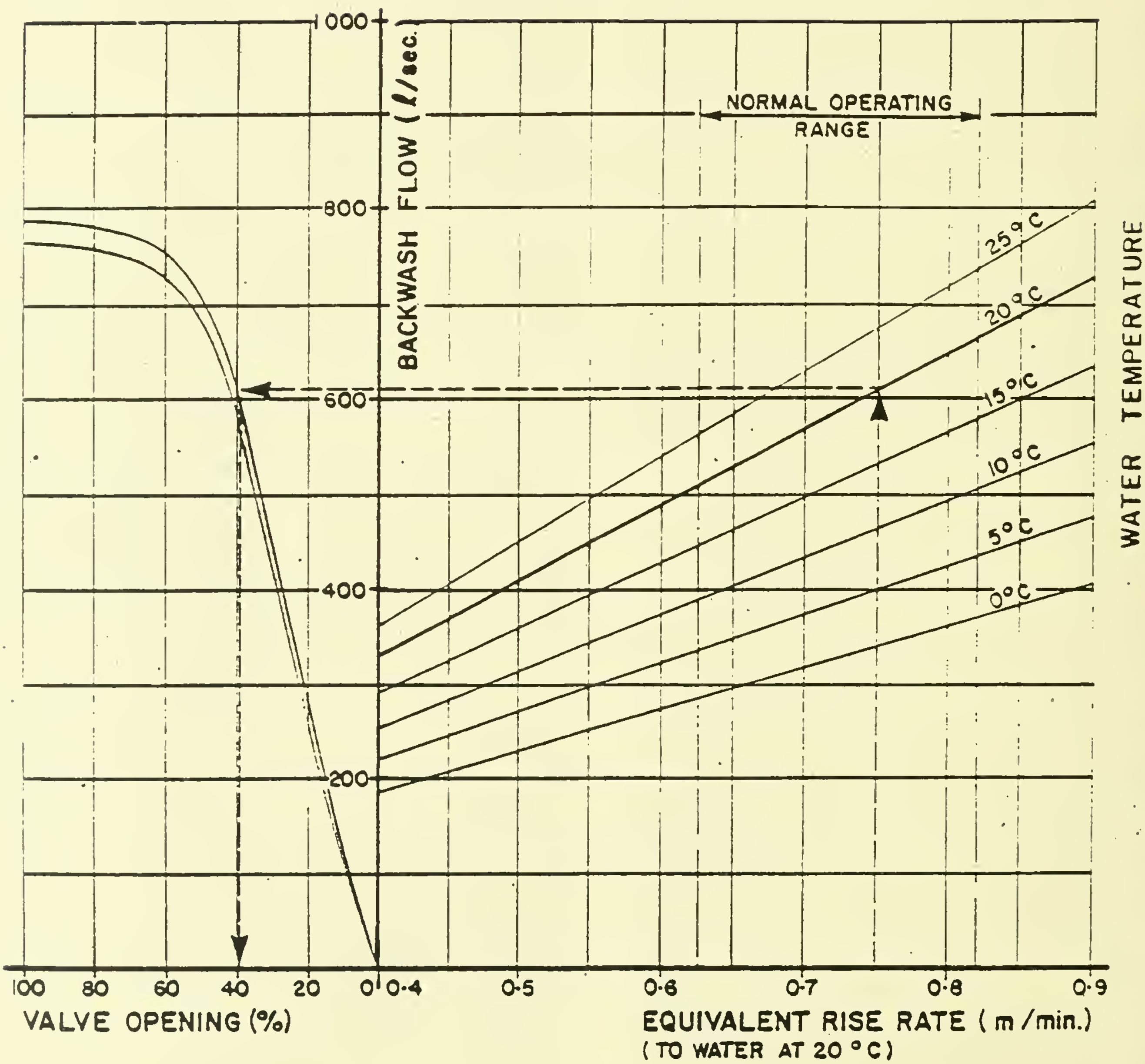
PUMP RUNNING TIME - IN HOURS											
ELAPSE TIME METERS	LOW LIFT PUMPS				HIGH LIFT PUMPS					BACK WASH	
	1	2	3	4	2	3	4	5		1	2
2400 HRS											
0000HRS											
TOTAL											
PUMP	LL1	LL2	LL3	LL4	HL2	HL3	HL4	HL5			
START/STOP											
START/STOP											
START STOP											
START STOP											
START/STOP											
START STOP											

REMARKS

LEVELS	DISTRIBUTION		
	RESERVOIR	SOUTH TANK	CRESCENT PARK TANK
	METRES	METRES	METRES
MIDNIGHT			
HIGHEST	TIME	TIME	TIME
LOWEST	TIME	TIME	TIME

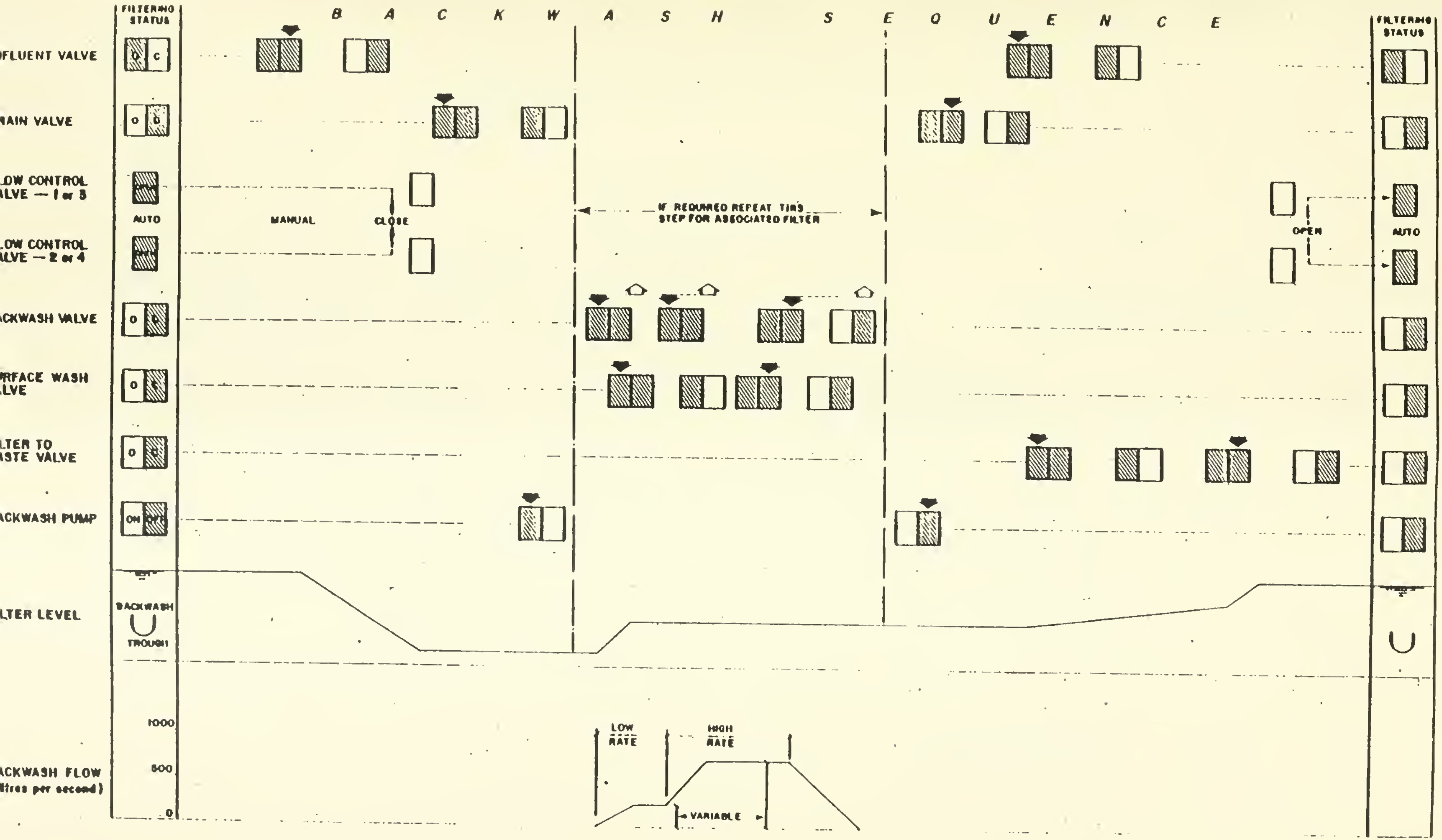
NOON READINGS	
HYDRO PEAK	KW
RAW WATER TEMP	C

APPENDIX C - DRAWINGS



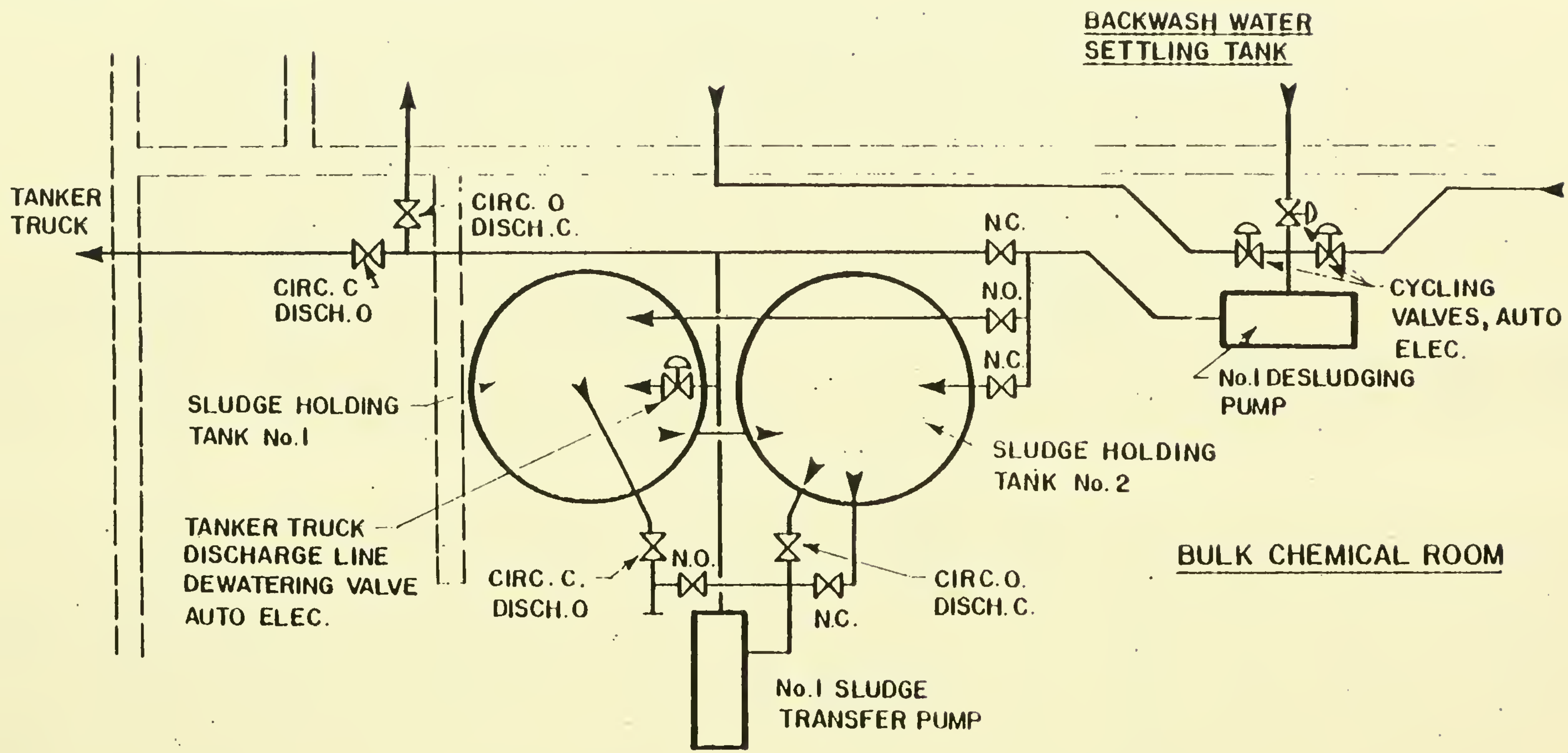
1000
800
600
400
200
BACKWASH FLOW (l/sec.)
NORMAL OPERATING RANGE
25°C
20°C
15°C
10°C
5°C
0°C
WATER TEMPERATURE
100
80
60
40
20
0
0·4
0·5
0·6
0·7
0·8
0·9
VALVE OPENING (%)
EQUIVALENT RISE RATE (m /min.)
(TO WATER AT 20 °C)

Fig. 1



FILTERING STATUS
B A C K W A S H S E Q U E N C E
FLUENT VALVE
AIN VALVE
LOW CONTROL
ALVE — 1 or 3
AUTO
MANUAL
CLOSE
LOW CONTROL
ALVE — 2 or 4
IF REQUIRED REPEAT THIS STEP FOR ASSOCIATED FILTER
OPEN
CKWASH VALVE
RFACE WASH
LVE
LTER TO
STE VALVE
CKWASH PUMP
ON
LTER LEVEL
BACKWASH
TROUGH
CKWASH FLOW
(litres per second)
1000
500
0
LOW RATE
HIGH RATE
VARIABLE

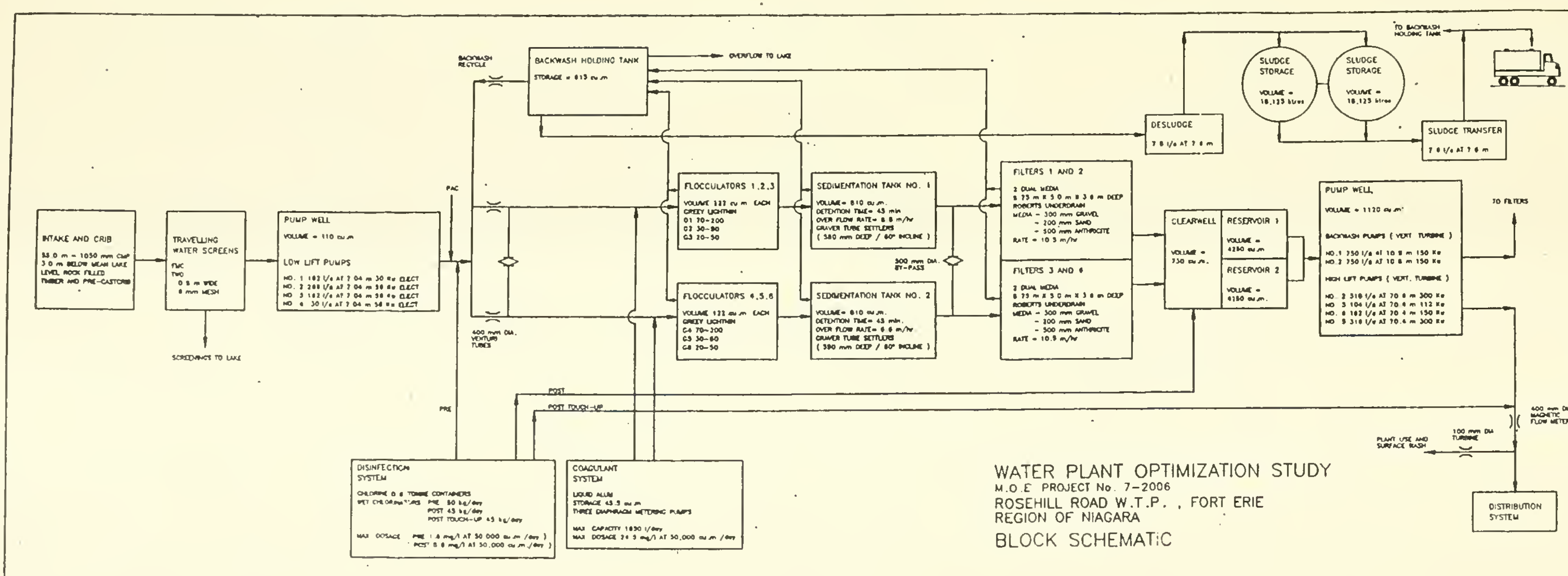
Fig. 2

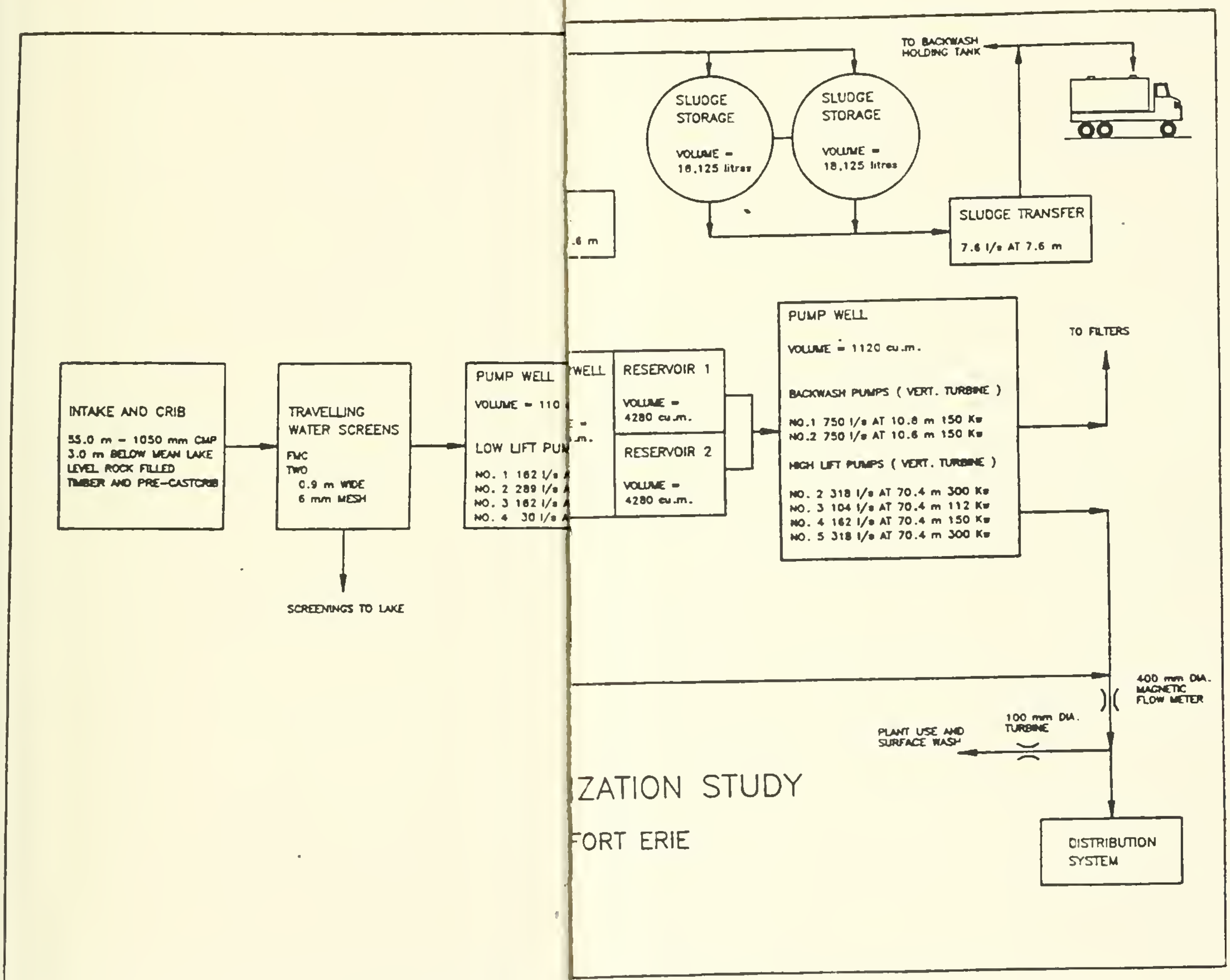


BASEMENT LEVEL PART PLAN

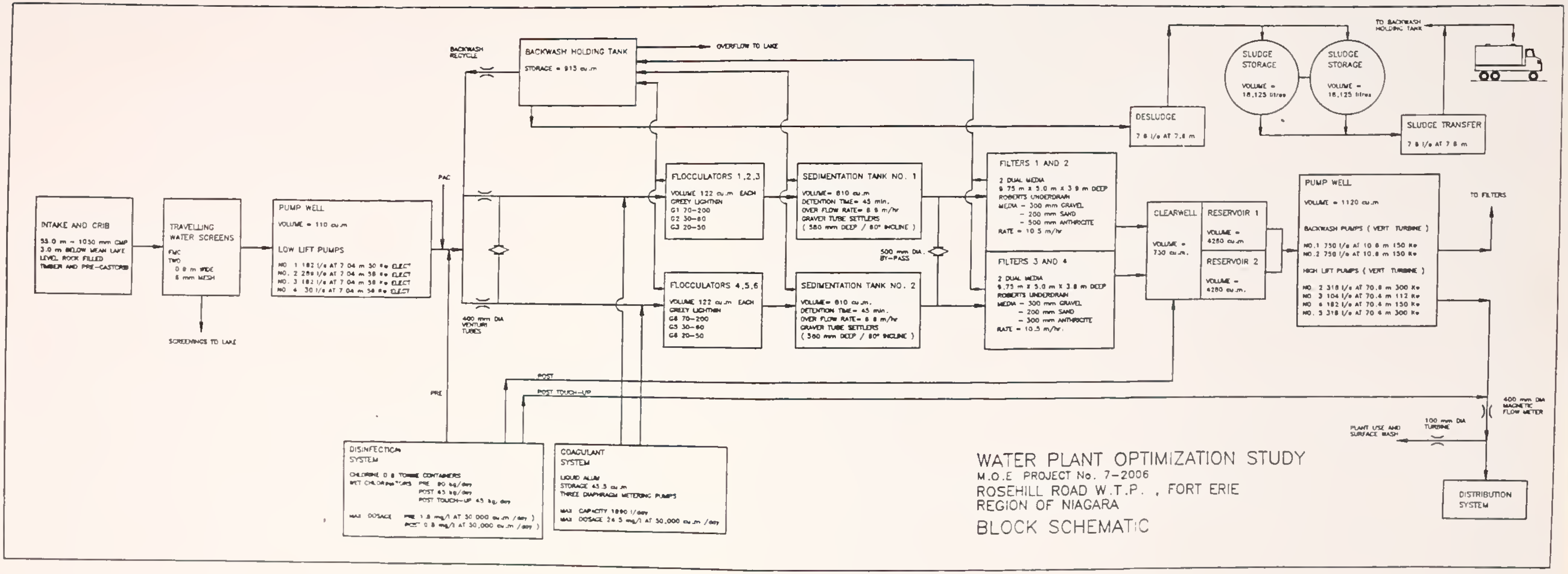
NTS

Fig. 3


INTAKE AND CRIB
TRAVELLING WATER SCREENS
SCREENINGS TO LAKE
PUMP WELL
VOLUME = 110 cu.m
LOW LIFT PUMPS
PAC
PRE
400 mm DIA. VENTURI TUBES
BACKWASH RECYCLE
BACKWASH HOLDING TANK
OVERFLOW TO LAKE
FLOCCULATORS 1,2,3
FLOCCULATORS 4,5,6
SEDIMENTATION TANK NO. 1
SEDIMENTATION TANK NO. 2
300 mm DIA. BY-PASS
FILTERS 1 AND 2
FILTERS 3 AND 4
CLEARWELL
RESERVOIR 1
RESERVOIR 2
DESLUDGE
SLUDGE STORAGE
SLUDGE STORAGE
SLUDGE TRANSFER
TO BACKWASH HOLDING TANK
PUMP WELL
BACKWASH PUMPS (VERT. TURBINE)
HIGH LIFT PUMPS (VERT. TURBINE)
TO FILTERS
400 mm DIA MAGNETIC FLOW METER
100 mm DIA TURBINE
PLANT USE AND SURFACE WASH
DISTRIBUTION SYSTEM
POST
POST TOUCH-UP
DISINFECTION SYSTEM
COAGULANT SYSTEM
LIQUID ALUM
THREE DIAPHRAGM METERING PUMPS
WATER PLANT OPTIMIZATION STUDY
M.O.E PROJECT No. 7-2006
ROSEHILL ROAD W.T.P. , FORT ERIE
REGION OF NIAGARA
BLOCK SCHEMATIC



TO BACKWASH HOLDING TANK
SLUDGE STORAGE
VOLUME = 18,125 litres
SLUDGE STORAGE
VOLUME = 18,125 litres
SLUDGE TRANSFER
7.6 l/s AT 7.6 m
PUMP WELL
VOLUME = 1120 cu.m.
BACKWASH PUMPS (VERT. TURBINE)
NO.1 750 l/s AT 10.6 m 150 Kw
NO.2 750 l/s AT 10.6 m 150 Kw
HIGH LIFT PUMPS (VERT. TURBINE)
NO. 2 318 l/s AT 70.4 m 300 Kw
NO. 3 104 l/s AT 70.4 m 112 Kw
NO. 4 162 l/s AT 70.4 m 150 Kw
NO. 5 318 l/s AT 70.4 m 300 Kw
TO FILTERS
INTAKE AND CRIB
55.0 m – 1050 mm CMP
3.0 m BELOW MEAN LAKE
LEVEL ROCK FILLED
TIMBER AND PRE-CASTCRIB
TRAVELLING WATER SCREENS
FMC
TWO
0.9 m WIDE
6 mm MESH
SCREENINGS TO LAKE
PUMP WELL
VOLUME = 110
LOW LIFT PUM
NO. 1 162 l/s A
NO. 2 289 l/s A
NO. 3 162 l/s A
NO. 4 30 l/s A
RESERVOIR 1
VOLUME = 4280 cu.m.
RESERVOIR 2
VOLUME = 4280 cu.m.
400 mm DIA. MAGNETIC FLOW METER
100 mm DIA. TURBINE
PLANT USE AND SURFACE WASH
ZATION STUDY
FORT ERIE
DISTRIBUTION SYSTEM


BACKWASH RECYCLE
BACKWASH HOLDING TANK
STORAGE = 913 cu.m
OVERFLOW TO LAKE
TO BACKWASH HOLDING TANK
SLUDGE STORAGE
VOLUME = 18,125 litres
SLUDGE STORAGE
VOLUME = 18,125 litres
DESLUDGE
7 8 l/s AT 7.8 m
SLUDGE TRANSFER
7 8 l/s AT 7 8 m
PAC
INTAKE AND CRIB
55.0 m - 1050 mm CMP
3.0 m BELOW MEAN LAKE LEVEL ROCK FILLED TIMBER AND PRE-CASTORB
TRAVELLING WATER SCREENS
FMC
TWO
0 8 m WIDE
6 mm MESH
SCREENINGS TO LAKE
PUMP WELL
VOLUME = 110 cu.m
LOW LIFT PUMPS
NO 1 182 l/s AT 7 04 m 30 Kw ELECT
NO. 2 289 l/s AT 7 04 m 58 Kw ELECT
NO. 3 182 l/s AT 7 04 m 38 Kw ELECT
NO 4 30 l/s AT 7 04 m 56 Kw ELECT
400 mm DIA VENTURI TUBES
FLOCCULATORS 1,2,3
VOLUME 122 cu.m EACH
GREEY LIGHTNIN
G1 70-200
G2 30-80
G3 20-50
FLOCCULATORS 4,5,6
VOLUME 122 cu.m EACH
GREEY LIGHTNIN
G4 70-200
G5 30-60
G6 20-50
SEDIMENTATION TANK NO. 1
VOLUME= 810 cu.m
DETENTION TIME= 45 min.
OVER FLOW RATE= 8 8 m/hr
GRAVER TUBE SETTLERS
(580 mm DEEP / 60° INCLINE)
SEDIMENTATION TANK NO. 2
VOLUME= 810 cu.m.
DETENTION TIME= 45 min.
OVER FLOW RATE= 8 8 m/hr
GRAVER TUBE SETTLERS
(580 mm DEEP / 60° INCLINE)
500 mm DIA. BY-PASS
FILTERS 1 AND 2
2 DUAL MEDIA
9 75 m x 5.0 m x 3 9 m DEEP
ROBERTS UNDERDRAIN
MEDIA - 300 mm GRAVEL
- 200 mm SAND
- 500 mm ANTHRACITE
RATE = 10 5 m/hr
FILTERS 3 AND 4
2 DUAL MEDIA
9.75 m x 5.0 m x 3.8 m DEEP
ROBERTS UNDERDRAIN
MEDIA - 300 mm GRAVEL
- 200 mm SAND
- 300 mm ANTHRACITE
RATE = 10.5 m/hr.
CLEARWELL
VOLUME = 730 cu.m.
RESERVOIR 1
VOLUME = 4280 cu.m
RESERVOIR 2
VOLUME = 4280 cu.m.
PUMP WELL
VOLUME = 1120 cu.m
BACKWASH PUMPS (VERT TURBINE)
NO.1 750 l/s AT 10 8 m 150 Kw
NO.2 750 l/s AT 10.8 m 150 Kw
HIGH LIFT PUMPS (VERT TURBINE)
NO 2 318 l/s AT 70.8 m 300 Kw
NO 3 104 l/s AT 70.4 m 112 Kw
NO 4 182 l/s AT 70.4 m 150 Kw
NO. 5 318 l/s AT 70 4 m 300 Kw
TO FILTERS
PRE
POST
POST TOUCH-UP
400 mm DIA MAGNETIC FLOW METER
100 mm DIA TURBINE
PLANT USE AND SURFACE WASH
DISTRIBUTION SYSTEM
DISINFECTION SYSTEM
CHLORINE 0 8 TONNE CONTAINERS
WET CHLORINATORS PRE 90 kg/day
POST 45 kg/day
POST TOUCH-UP 45 kg/day
MAX DOSAGE PRE 1.8 mg/l AT 50 000 cu.m /day)
POST 0 8 mg/l AT 50,000 cu.m /day)
COAGULANT SYSTEM
LIQUID ALUM
STORAGE 45.5 cu.m
THREE DIAPHRAGM METERING PUMPS
MAX CAPACITY 1890 l/day
MAX DOSAGE 24 5 mg/l AT 50,000 cu.m /day
WATER PLANT OPTIMIZATION STUDY
M.O.E PROJECT No. 7-2006
ROSEHILL ROAD W.T.P. , FORT ERIE
REGION OF NIAGARA
BLOCK SCHEMATIC

APPENDIX D - TERMS OF REFERENCE

WATER PLANT OPTIMIZATION STUDY
PLANT INVESTIGATION AND PROCESS EVALUATION STUDY
TERMS OF REFERENCE

Purpose

To review the present conditions and determine an optimum treatment strategy for contaminant removal at the plant, with emphasis on particulate materials and disinfection processes.

Work Tasks

1. Receive a package of available information on the plant from the MOE. Review the information provided and meet with the MOE staff to discuss the project.

2. Document the quality and quantity of raw and treated waters. Along with Work Task 3, send a progress report to the Project Committee at the conclusion of this work.

3. Define the present treatment processes and operating procedures. Along with Work Task 2, send a progress report to the Project Committee at the conclusion of this work.

4. Assess methods of efficient particulate removal which would utilize the present major capital works of the plant. Evaluate the particulate removal efficiency and sensitivity of operation, assuming optimum performance of the plant. Along with Work Task 5, send a progress report to the Project Committee at the conclusion of this work.

5. Assess methods which would improve, if necessary, the disinfection practices of the plant, keeping in mind a desire to minimize the production of chlorinated by-products in the treated water. Along with Work Task 4, send a progress report to the Project Committee at the conclusion of this work.

6. Describe possible short and long-term process modifications to obtain optimum disinfection and contaminant removal, with emphasis on particulate removal and a desire to minimize the production of chlorinated by-products. Meet with the Project Committee at the conclusion of this work to review the report information.

7. Prepare 7 copies of the draft report and submit to the Project Committee.

8. Review the Project Committee's comments and prepare 25 copies of the final report.

11/08/86

1. RECEIVE A PACKAGE OF AVAILABLE INFORMATION ON THE PLANT FROM THE MOE. REVIEW THE INFORMATION PROVIDED AND MEET WITH THE MOE STAFF TO DISCUSS THE PROJECT.

Elements of Work

(a) Receive a package of available information from the MOE concerning the plant.

(b) Review the information and otherwise prepare for a meeting to initiate work on the project, including preparation of a schedule of manpower and staff requirements.

(c) Meet with the MOE to discuss the available data, the terms of reference, and the project staff and work schedule.

2. DOCUMENT THE QUALITY AND QUANTITY OF RAW AND TREATED WATERS. ALONG WITH WORK TASK 3, SEND A PROGRESS REPORT TO THE PROJECT COMMITTEE AT THE CONCLUSION OF THIS WORK.

Elements of Work

(a) Tabulate the daily raw and treated water flows for the last three consecutive years.

(b) Document the methods of measuring the raw and treated water flow rates, and assess the validity of the records.

(c) Prepare a monthly summary of maximum, minimum, and average flows for the three years. Address any discrepancies which exist between raw and treated flow rates.

(d) Review and assess the monthly maximum, minimum, and average per capita flow for the three years. Compare the plant data with typical per capita flows for the local region.

(e) Document a summary, based on at least three years of data, of the raw and treated water quality testing data for physical, microbiological, radiological, and chemical water quality information. Document as much data as is needed to show possible seasonal trends in water quality. Where possible, show corresponding sets of raw and treated water quality information. Document the source and methods used in determining all water quality information. Assess the validity of the data, comparing plant and outside laboratory data.

(f) Tabulate, for the last three consecutive years, where available, raw and treated water turbidity, residual aluminum, pH, and colour. Record other data, such as particle counting, suspended solids, and algae counting, which could reflect on particulate removal efficiency. These data should be used for assessment of the particulate removal efficiency of the plant. Document the source and methods used in determining all information. A comparison should be made between the plant and outside laboratory information to ascertain the relative validity of the data. For plant data, emphasis should be given to plant laboratory tests rather than continuous process control instruments.

(g) Tabulate, for the last three consecutive years, the raw water bacterial test information at the plant. Also tabulate the corresponding treated water tests at the plant which register positive results. Document the source and methods used for all data provided. This information should be used to assess the effectiveness of the disinfection practices at the plant.

(h) Identify and recommend other water quality concerns, not related to particulate removal or disinfection, which should be considered as part of the assessment phase of this evaluation program.

(i) Submit a progress report to the Project Committee.

3. DEFINE THE PRESENT TREATMENT PROCESSES AND OPERATING PROCEDURES. ALONG WITH WORK TASK 2, SEND A PROGRESS REPORT TO THE PROJECT COMMITTEE AT THE CONCLUSIONS OF THIS WORK.

Elements of Work

(a) Where drawings are available, assemble sufficient record drawings, of a reduced size, to document the general site layout and the interrelationship of major plant components. If not already available, prepare a process and piping diagram (PAPD) of the plant operations.

(b) Prepare a simplified block schematic of the major plant components.

(c) Prepare a photographic record of the plant facilities, illustrating all of the major plant components and chemical feed systems.

(d) Tabulate the design parameters for all of the major plant components, with emphasis on the process operations, including chemical feeds. This information, as a minimum, must be consistent with the DWSP Questionnaire and must be confirmed and verified by field observations.

(e) Prepare a brief summary of how the plant is operated, including chemical dosage control, such as jar testing information, filter backwashing procedures and initiation, and pumping and flow control.

(f) Document and assess any reported problems in plant operations and/or in the distribution system related to water quality.

(g) Tabulate the daily average chemical dosages for the last three consecutive years. Document the methods used to evaluate chemical dosages and establish the validity of the dosage information provided.

With regard to disinfection, tabulate the dosages of chlorine and disinfection-related chemicals such as chlorine dioxide. In addition, provide corresponding data on disinfectant residuals in the plant, such as free and total chlorine residuals. Also, provide chlorine demand tests where available. Again, document the methods of dosage evaluation and residual measurements, and establish the validity of the data provided.

(h) Submit a progress report to the Project Committee.

4. ASSESS METHODS OF EFFICIENT PARTICULATE REMOVAL WHICH WOULD UTILIZE THE PRESENT MAJOR CAPITAL WORKS OF THE PLANT. EVALUATE THE PARTICULATE REMOVAL EFFICIENCY AND SENSITIVITY OF OPERATION, ASSUMING OPTIMUM PERFORMANCE OF THE PLANT. ALONG WITH WORK TASK 5, SEND A PROGRESS REPORT TO THE PROJECT COMMITTEE AT THE CONCLUSION OF THIS WORK.

Elements of Work

(a) Using information provided in Work Tasks 1 and 2, evaluate the plant's particulate removal efficiency. The basis of minimum particulate removal should be 1.0 FTU, which is the maximum acceptable concentration of the Ontario Drinking Water Objectives (Table 1, page 2, Ontario Ministry of the Environment, Revised 1983). It should, however, be recognized that it is desirable to strive for an operational level which is as low a turbidity level as is achievable.

(b) Conduct an evaluation of possible optimum performance alternatives, including jar testing of plant water samples.

(c) Evaluate the feasibility of optimum removals using the existing plant capital works. This evaluation should consider the worst case water quality conditions, even though field testing data may not be available during the initial phase of the study (see Work Task 7).

(d) Describe the operational procedures, management strategies, and equipment required for various feasible alternatives. Estimate chemical dosages, level of operational expertise, and sensitivity of operation of the alternatives.

(e) Submit a progress report to the Project Committee.

5. ASSESS METHODS WHICH WOULD IMPROVE, IF NECESSARY, THE O PRACTICES OF THE PLANT, KEEPING IN MIND A DESIRE TO MINIMIZE THE OF CHLORINATED BY-PRODUCTS IN THE TREATED WATER. ALONG WITH WOR SEND A PROGRESS REPORT TO THE PROJECT COMMITTEE AT THE CONCLUSIO WORK.

Elements of Work

(a) Using the information provided in Work Tasks 1 and 2, evaluate t ability to disinfect the water. The basis of minimum disinfect be to ensure a water quality as described in the Ontario Drin Objectives (Ontario Ministry of the Environment, Revised 1983).

(b) Conduct an evaluation of possible optimum disinfection procedure plant, with consideration also given to the reduction of by-products in the treated water.

(c) Evaluate the feasibility of the various alternatives using the plant capital works. Estimate the initial and final levels of by-products for the various alternatives. Assess the relative the alternatives.

(d) Describe the operational procedures, management strategies, and required for the feasible alternatives. Estimate chemical dosag of operational expertise, and sensitivity of operation alternatives.

(e) Submit a progress report to the Project Committee.

6. DESCRIBE POSSIBLE SHORT AND LONG-TERM PROCESS MODIFICATIONS TO OBTAIN OPTIMUM DISINFECTION AND CONTAMINANT REMOVAL, WITH EMPHASIS ON PARTICULATE REMOVAL AND A DESIRE TO MINIMIZE THE PRODUCTION OF CHLORINATED BY-PRODUCTS. MEET WITH THE PROJECT COMMITTEE AT THE CONCLUSION OF THIS WORK TO REVIEW THE REPORT INFORMATION.

Elements of Work

(a) It is not the purpose of this study to provide a detailed implementation scheme for plant rehabilitation. It is, however, necessary to scope the feasible short and long-term process modifications required to achieve optimum disinfection and contaminant removals.

Prepare a list of modifications which should be considered for detailed implementation evaluation. Provide an estimated cost for each of the proposed modifications.

(b) Prepare a schedule for the list of modifications.

(c) Meet with the Project Committee at the plant site to review the proposed modifications.

7. PREPARE 7 COPIES OF THE DRAFT REPORT AND SUBMIT TO THE PROJECT COMMITTEE.

Elements of Work

(a) The report must include all the information reported previously in the study. The information must be organized and presented in a logical and co-ordinated fashion.

A general table of contents will be provided for organizing the material in a manner consistent with other plant reports.

(b) Submit the draft report to the Project Committee for review.

(c) Prepare a separate letter report containing a recommendation(s) concerning the need for additional field testing to cover water quality conditions not available during the period of this study. The Project Committee may decide to delay completion of the final report until field data can be obtained to confirm the predictions of performance for the worst case water conditions.

8. REVIEW THE PROJECT COMMITTEE'S COMMENTS AND PREPARE 25 COPIES OF THE FINAL REPORT.

Elements of Work

(a) Conduct additional field testing if required. Discuss the implications of the results with the Project Committee if the results differ from the predicted performance.

(b) Amend the report as per review comments, incorporating additional field data if required.

(c) Submit copies of the final reports to the MOE for distribution.